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■ Great
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■ First Looks:
The Right
Backup Drive
For You

■ The Very
Worst of
Abort,
Retry, Fail



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THE INDEPENDENT GUIDE TO PERSONAL COMPUTING VOL. 17 NO. 1 JANUARY 6, 1998

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The Ever-Evolving PC



In our previous issue, we focused on products that made breakthroughs in technology—those that received our annual Awards for Technical Excellence. This issue, we turn our sights to the best of all products of the past year (for that story, see page 100). These products stood out within their categories, and many

have been Editors' Choice winners.

But as I look over the list, I'm struck by the realization that often, individual products are not what change our computing lives. Rather, it's the way that multiple computer products work together (or don't), and the result of all these products coming together.

Perhaps the biggest change in the way I used computers this year has been with e-mail. A lot more people I know—not only in my professional life but also in my personal life—now have e-mail addresses that are accessible through the Internet.

On the business side, it's been a relatively smooth progression as more people are getting Internet-capable e-mail. Corporate e-mail systems, such as Lotus Notes and Domino, Microsoft Exchange and IIS, Novell's GroupWise, and Netscape Communicator and SuiteSpot, have improved and have begun to offer more direct Internet connections. E-mail gateways, proxies, and firewalls have become much more capable and robust.

E-mail's growth at home and in small business has been more phenomenal. As far as personal mail goes, a lot of the credit goes to companies like America Online, Microsoft, and Netscape for making the Internet accessible to more people. Of course, in taking credit, these companies should also take some blame for the increase in junk e-mail. But Internet service providers as a group have done a good job of improving service while keeping prices relatively low. Thus, more people are connecting.

And the growth of e-mail has been helped along by the surge of relatively inexpensive yet very powerful personal computers. Today, for less than \$1,000, you can get a Pentium-class machine with 32MB of RAM and a couple of gigabytes of hard disk space. That's more computer than any of us had five years ago. And

for less than \$2,500, you can get a 266-MHz machine with more than 6GB of hard disk storage, plus a fast 3-D graphics card and a 17-inch monitor.

Lots of power means lots of users. Computer Intelligence reported that as of July, more than 42 million U.S. households (out of a total of about 100 million) had PCs. And about 18 million were connected to the Internet, either directly or

through an online service. That's more than five times the number connected anywhere at the start of 1995.

Now I can still complain that PCs are too hard to use. That Windows 95 and NT 4.0 are difficult to manage on a corporate level. That individuals shouldn't have to put up with the craziness caused by things like Registry settings, installation routines, and Plug and Play (or is that *plug and pray*?). There are certainly plenty of things that need to be improved.

But generally, things keep getting better. I'm not about to go back to a 286 and DOS 3.1, and I'm sure you're not either.

And look at all the things 1998 will bring. For many people, Internet connections will become faster, thanks to speedier analog modems, cable modems, and more high-speed phone connections. The Net will surely become more dynamic and graphical. Electronic commerce is changing from a curiosity to a mainstream way of doing business. E-mail usage feeds on itself, so it will continue to grow. PC makers will continue to give us more machine for our money. Little devices we can carry everywhere, like the Palm Pilot, will proliferate. And new, more limited but easier-to-use machines—such as those from WebTV—will likely become more common.

Individually, any of these changes is significant. But when you put them all together, then suddenly the PC revolution is about more than just faster, better computers. It becomes more about changing the way we work and live.

A stylized, handwritten signature of Michael J. Miller in black ink.

MICHAEL J. MILLER

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256KB L2 pipeline burst cache
PCI bus with 128-bit graphics accelerator
MPEG compatible
Zoomed Video capable
Touchpad pointing device
Microphone and 16-bit stereo sound
2 Type II/1 Type III PCMCIA slots
2-way Infrared port
Modular floppy drive
Microsoft Windows 95 and MS Plus! Companion
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(features MMX technology)
Intel 82440LX chip set
512KB internal L2 cache, 2MB BIOS
64MB SDRAM
6.4GB Ultra ATA hard drive
24X EIDE variable speed CD-ROM drive
3.5" floppy drive
100MB Iomega Zip drive
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COVER STORY

THE Best

OF 1997



BY JAKE KIRCHNER

It's always a challenge, but one we really enjoy. Once again, we've looked back over the thousands of products we reviewed in the past year and come up with this short



list of the best in their class. Selecting from so many excellent products wasn't easy, but here are our favorites. See if you agree100

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The Sweetest Sounds

How can you tell whether your PC's sound system is letting those CD-ROMs, games, and Web sites sing out in all their glory? Why not download the sound files we used to test audio subsystems for this issue's comparative evaluation? Try them out and see how they sound. We tell you what to listen for and how to upgrade if it's time for a change.

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PC SOUND

The Shifting Soundscape



BY KEN C. POHLMANN AND WILL PIRKLE

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INTERNET

Web Travel Sites: Be Your Own Agent



BY WILL FASTIE

Here's yet another great use for the Web, with all its immediacy and broad-reaching access to information. Indeed, we found lots of promising travel sites out there, but not all of them live up to their potential. Right now, most of these sites are much better at handling business travel than helping you make your vacation plans, but we think this will change before long. We assess the sites that do the best job and help you most from start to finish.....177

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The New York Times

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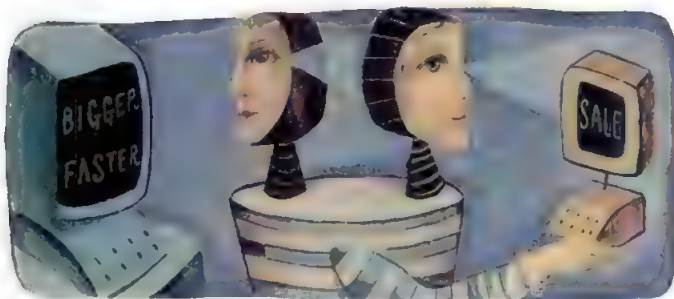
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Pipeline

Sub-\$1,000 Sweet Spot



A year ago, PC manufacturers targeted first-time buyers with a new class of systems costing under \$1,000. It turns out that so-called "sub-zero" systems are more popular with repeat buyers, reveals market research firm Computer Intelligence (a division of Ziff-Davis, the publisher of *PC Magazine*).

Targeted at the home market, these systems—which can cost a third of the price of a top-of-the-line PC—aren't as powerful or full-featured as some users may need. A typical system has a generation-old CPU, a 14-inch monitor, and just enough RAM to run Windows. "First-time PC buyers are staying away from the systems, most likely because new users want PCs that have longer life spans," says Computer Intelligence analyst Matt Sargent.

According to Computer Intelligence, sub-zeros account for nearly 27 percent of the home

PCs sold through the retail market—up from roughly 23 percent at the beginning of the summer.

Until recently, sub-zeros were refurbished systems or third-tier brands. The industry is now dominated by Acer, AST Research, Compaq, and Packard Bell NEC.

So what does \$999 get you? From Packard Bell NEC you can buy a 120-MHz or 133-MHz system, with or without a monitor, for less than \$1,000. Compaq offers a 200-MHz Presario for \$999, without a monitor. And IBM made its debut in the fall with its 166-MHz Aptiva E16, \$999, which does not include a monitor.

In an effort to keep up with AMD and Cyrix, which have already made substantial investments in the sub-zero market, Intel has plans to develop a Pentium II processor for the market by the end of next year.



"Microsoft now has the ability to virtually annihilate any competitive product it wants by bringing it into the next version of Windows."

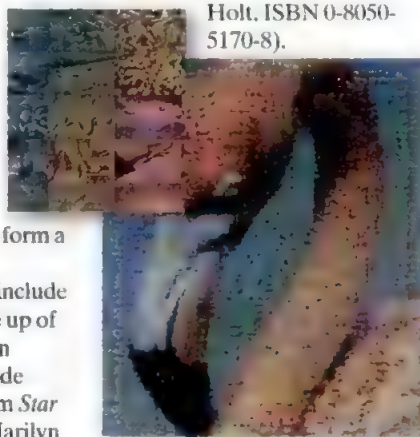
—Senate Judiciary chairman **Orrin Hatch** (R-Utah) on the eve of a Senate hearing on the Internet and electronic commerce, shortly after the Justice Department filed an antitrust suit against Microsoft.

Photomosaic Art

As a graduate student at MIT's Media Lab, artist Robert Silvers developed a program called Photomosaics and launched a new technique in digital art. The software sorts thousands of tiny images by color, density, internal shapes, and light and arranges them so that when viewed from a distance, they combine to form a single larger image.

Silvers's works to date include *The Flower Carrier*, made up of 2,000 photos of flowers; an image of Darth Vader made from digitized frames from *Star Wars* films; an image of Marilyn Monroe composed of *Life* magazine covers; and an image of Abraham Lincoln composed of more than 1,000 Civil War photographs. Silvers used Silicon Graphics workstations

loaded with 30GB of disk space and 256MB of memory to turn out photomosaics for his first book, *Photomosaics* (Henry Holt, ISBN 0-8050-5170-8).

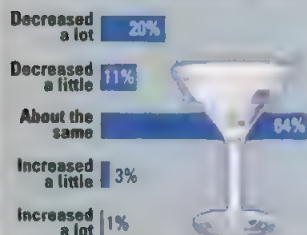


The 28-year-old artist launched his own company, Runaway Technology (www.photomosaic.com), to create custom images for clients and license his work.

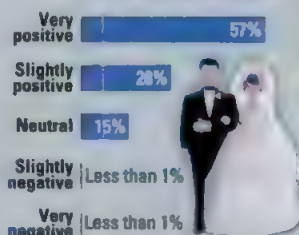
Wholesome Values

The Internet is nourishing some good, wholesome values. In a recent poll Internet users reported fewer bar visits, better family relationships, and improved communication with family and friends.

Time Spent in Bars and Clubs



Effect on Relationships



Source: ActivMedia's FutureScapes study.

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Our Best-of-The-Year Guided Tour

We captured the highlights of our gala annual awards ceremony. Download RealPlayer and watch what happened.

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Take a Trip On the Web

Bookmark our list of the best travel sites to make sure you'll always have the best seat on the plane.

PC Tech Debuts Online

Get advice, see how our utilities are written, and keep up with the latest programming tricks.

And Don't Miss These Web Extras

We have daily reports from the PC industry's cutting edge and weekly commentary from John C. Dvorak, Michael Miller, and Don Willmott.

Pipeline

Did Sun Cheat?



Pendragon Software—maker of the CaffeineMark Java benchmark test—recently fired a salvo at Sun Microsystems, claiming that Sun had optimized compilers in its operating system Solaris 2.6 in order to juice performance on the CaffeineMark test.

After putting in a blazing performance on the benchmark test, Sun issued a glowing press release claiming that it had outperformed Windows NT systems on the test. Pendragon president Ivan Phillips cried foul, saying the results weren't representative of real-world Java performance and that Sun had gone so far as to duplicate the test's code within Sun's Just-In-Time compiler. That's cheating, says Phillips, who claims that benchmark tests and real-world applications aren't the same thing.

Did Sun issue a denial or a mea culpa? Initially, Sun neither denied optimizing for the benchmark test nor apologized for it. "If the test results are not representative of real-world Java applications, then that's a problem with the benchmark," Sun's Brian Croll said.

After taking a beating in the press, though, Sun retreated and issued an apology for the optimization. SunSoft president Janpieter Scheerder said Sun had "violated the intent of the benchmark, and we're sorry."

Shopping in Space

Flight Commander Anatoly Soloviyev and Flight Engineer Pavel Vinogradov plan to be floating 200 miles above Earth inside the space station Mir until February, but that hasn't stopped them from doing a little holiday shopping. The cosmonauts recently made history by placing the first online order from space.

They used Virtual Emporium's online personal shopper

(www.virtualemporium.com) to select two Pentium II systems, then e-mailed their choices to Virtual Emporium, where the request was translated into English. The order was placed on Gateway's Web site and received in Gateway's facility in Kansas

City, Missouri.

Then the order was processed and forwarded to Gateway's manufacturing plant in Dublin, Ireland, where the PCs will be built and shipped to Russia.

That's about as far as Gateway will deliver the order.



Cosmonaut entering cyberspace.

Personal Solar System

You're on safari and your notebook's battery runs out. No need to panic. Sunwise Technologies' solar power system can generate up to 9 watts of power, recharge the battery, and put you back in business.

When used with one panel, the system can "double or triple" battery runtime, according to the company. Set up two panels and you have enough power to run a notebook without depleting the battery at all.

The Kingston, New York, company designed its Portable Energy System (\$349) for use

where there's no utility power or where power sources are unreliable. The system includes a solar panel—its photovoltaic cells store power—as well as a voltage controller, interconnect cables, and a carrying case.

You're out of luck, though, if you happen to need a recharge at night or during overcast weather.



A New Gateway to the Web

Gateway 2000 is branching out into the Internet service provider (ISP) business with its new Gateway.Net, a service that's designed for customers ordering new PCs. The logic is that the process of hooking up with an ISP is a huge barrier to Internet access for many first-time computer buyers.

Gateway's ISP software comes preloaded on systems, so no configuration is required. CEO Ted Waitt claims the service has a "99 percent connect rate." Customers will get up to 30 hours of online time for \$12.95 a month, with additional time costing \$2.95 an hour.

The marketing novelty could have its downsides. The ISP business is ruthlessly competitive, and heavy traffic can lead to access headaches for both customers and providers.



Top-Selling Retail Games

- 1 **Microsoft Flight Simulator** Microsoft
- 2 **Myst** Broderbund
- 3 **Star Trek: Starfleet Academy** Interplay
- 4 **Dark Reign: The Future of War** Activision
- 5 **Dialo** CUC Software
- 6 **NASCAR II** CUC Software
- 7 **Command & Conquer Red Alert** Virgin
- 8 **Hexen 2** Activision
- 9 **Monopoly Game CD-ROM** Hasbro
- 10 **Links LS 1998** Access

Source: PC Data. Data for September.

THIS ISSUE'S CONTRIBUTORS: *Angela Hickman, Carol Levin, Sebastian Rupley, and Don Willmott.*

If you look closely,
you can almost see your
competitors crying.

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A jester in a red and white striped outfit with a pointed hat stands on a stone ledge. Below the ledge is a body of water reflecting the jester. The image is used to demonstrate resolution levels. Two text boxes are overlaid: one on the left and one on the right. The left box says 'AT 360 DPI YOU SEE A JUGGLER.' and the right box says 'AT 720 DPI YOU SEE HE'S LOOKING AT HIS REFLECTION.' The jester is looking down at his reflection in the water.

A digital illustration of a jester in a red and white striped outfit, a tall pointed hat with a red and white striped band, and a red and white striped skirt. He is standing on a stone ledge, looking down at his reflection in a pool of water. The background is a clear blue sky. Two callout boxes are present: one on the left says "AT 360 DPI YOU SEE A JUGGLER." and one on the right says "AT 720 DPI YOU SEE HE'S LOOKING AT HIS REFLECTION." The image is a high-resolution digital print.

YOU'VE GOT TO SEE IT IN

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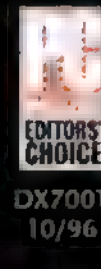
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Letters

READING THE FINE PRINT

I enjoyed your article in the November 4 issue about color printers ("Personal Printers") and agree about the capabilities and output quality of the Epson printers. No other manufacturer comes close to Epson's print quality. But I notice you didn't mention another very important printer feature: the ability to feed paper automatically from the paper tray. I would like to know if you had any trouble with the paper-feed mechanism of any color ink jet printers you tested in this roundup. Perhaps Epson has improved the paper feed on the Stylus Color 400, 600, and 800, but since the day I began using my Stylus Color II, I have had paper-feed problems. The mechanism is very poorly designed, and if you rated these printers on their paper-feed abilities alone, Hewlett-Packard would win hands down.

TIM SWALLOW
via the Internet

I don't see why you gave an Editors' Choice award to the HP DeskJet 722C for home PCs and to the Epson Stylus Color 800 for business. Your choices are inconsistent. The output from the Epson Stylus Color 600 looked just as good to me as the 800's. Both looked better than the HP DeskJet 722C or 890Cse. I'm not sure about Epson, but HP uses the exact same printing technology in the 722C and 890Cse, the only difference being that the 890Cse is a little faster. I have an HP DeskJet 870Cse and an HP OfficeJet 1150Cse, and I don't see much improvement in the 890Cse's output, if any. For all of the hype about Hewlett-Packard's new technology and new color cartridge, I would expect to see a dramatic improvement over the HP DeskJet 820Cse and 870Cse, and it just isn't so.

LAWRENCE SHERRY
via the Internet

I found your selection of the HP DeskJet 722C as Editors' Choice for home ink jet printers very confusing. I own an Epson Stylus Color 600, and I read the story to see how its performance compared with that of other printers. In your rating of objective print quality, the Epson Stylus Color 600 rated *good* in all four categories, and the HP DeskJet 722C rated *fair* in two categories and *poor* in the other two. The 600 has a \$300 street price; the 722C, \$350. In the Summary of Features, there isn't a single area in which the 722C beat the 600, but there are several features the 600 has that the 722C does not. The 600 is clearly a better choice.

MATTHEW BAGBY
via the Internet

Although ratings in objective print quality were higher for the Epson Stylus Color 600, in subjective evaluation the HP DeskJet 722C had a slight



"I don't agree with your Editors' Choices for home and business units."

edge on some images. Print quality is only one of the factors that figure into our final Editors' Choice selections; we also take into account ease of setup and use, the software bundle, and the vendor's service and support. We still feel, all things considered, that the HP DeskJet 722C is the best ink jet printer for the home user.—Ed.

The Brother MFC-4550 printer is all you said it is in terms of print quality and performance, but it has one important flaw. Every time I try to print a page off the Internet, I lose my connection. I called Brother's technical support on two occasions, and after downloading some newer drivers to no avail, I was told that this particular model is known to have that disconnect problem. It has something to do with the communications between the printer and the computer. I think that your testing procedures should be enhanced to check for this problem, especially since the Internet has become such an important part of our computing lives.

DOUG KELNER
via the Internet

PAPER PORTING

You were right on with your Editors' Choice of PaperPort Deluxe 5.1 for document imaging software ("Taming the Paper Tiger," November 4). But I am perplexed. You gave the award for flatbed scanners to the Visioneer PaperPort 6000 (First Looks, "Value-Minded Flatbeds"), largely because of the included Deluxe 5.1 software. There was, however, no mention of the PaperPort 3000, which also bundles Deluxe 5.1 and sells for \$179.

BILL STOEBIG
Alpharetta, Georgia

YES, JOHN, GATEWAY STORES DO EXIST

In his November 4 Inside Track column, John C. Dvorak suggested that Gateway 2000 open up computer stores. Here in Cincinnati, Gateway has operated a retail computer store since about last Christmas. It is across the street from a mall that has a CompUSA store. I have not been in it. As a customer who has been mistreated by Gateway, I have no reason to go there, although I sometimes wave as I go by on my way to CompUSA.

JEFF TINCH
Cincinnati, Ohio

I live in Melbourne, Florida, and have visited Gateway 2000 Country Stores in Jacksonville, Orlando, and Tampa, and I know that there are more in Atlanta. These stores have opened up in the past six months and have a rustic look and feel. Inside are dozens of home, business, and portable configurations set up for you to look at and play with. Friendly, low-pressure salespersons help you and take your order for later delivery to your home or business. Viewing rooms are set up for looking at Destination systems and surfing the Web. No stock units are kept on hand for immediate sale, and there doesn't appear to be a tech-support center on site, although there are training centers.

MARK CHILES
Melbourne, Florida

RUMORS IN THE VALLEY

In his November 4 column ("In Bed with Apple, Intel, and Microsoft"), Dvorak writes: "The rumor in the Valley is that Apple will adopt the Intel microprocessor. The reason is obvious: price." Excuse me, but what alternative universe is he living in? For one thing, the PowerPC chips right now have better performance than anything Intel is putting out. This will not change until the release of Merced (1999 or later), at the earliest. It may not change at all. Second, PowerPC chips cost less than Intel chips. Though Apple may very well move to Intel chips, the price of the chips will not be the reason.

GREG DOUGHERTY
via the Internet

If the rumor Dvorak mentions comes to pass, one might wonder why Apple would have agreed not to license the Mac shell. The answer is that this would be another example of Microsoft's questionable licensing agreements. Some years ago, Microsoft got into trouble for requiring computer makers to pay a royalty for every computer sold—regardless of what operating system was preinstalled—in return for giving the computer maker a lower price for DOS. This all but forced peo-

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Letters

ple to use DOS. Now, since no one but Apple will be allowed to sell the Mac shell, this restriction will all but force people to use Windows even though the Mac OS will be available on Intel computers.

STEVEN WHITE
Minneapolis, Minnesota

Dvorak's column raises some concerns about where the computer industry is headed. On one hand, as a former Mac owner, I rejoice at the prospect of running the Mac OS (in some form) on my PC. I also shiver at the same time: Intel's interest in the Alpha chip, for example, and now the rumor that the PowerPC may be no more solidify Intel's grasp of the x86 market. Microsoft's interest in Apple—and vice versa—worries me. I fear this is only the beginning of the end for healthy competition in the computer arena.

BRAD WIEBE
via the Internet

TESTING AND TWEAKING

In your Trends article "The Great Java Rift" (October 21), you state that "Developers are finding that [Java] can be everywhere only after it's tested and tweaked....So much for 'portability.'" Ease of portability is nothing to sneer at. Any development effort to port an application to multiple platforms involves testing and tweaking and usually results in multiple sets of code that must be maintained independently. The fact that once the tweaking to Java code is done, the result will run on multiple platforms is truly a giant leap in the right direction.

IAN SHERWOOD
via the Internet

HOW TO CONTACT US

We welcome your comments and suggestions. Please send Letters to the Editor via

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All letters become the property of PC Magazine and are subject to editing.

We regret that we cannot answer letters individually. To send submissions for PC Solutions, please see the sidebar "How to Contact Us" on the last page of that column.



CORRECTIONS AND AMPLIFICATIONS

In our review of LaserFiche Desktop ("Taming the Paper Tiger," November 4, 1997), we stated incorrectly that the client does not support 16-bit Twain scanners. LaserFiche Desktop and the network client are currently 16-bit applications with support for Microsoft Windows 3.11, Windows 95, and Windows NT 4.0 Workstation. The network versions run on a 32-bit server with support for NetWare and Windows NT. Within the past year, LaserFiche has added support for 16-bit Twain scanning.

Also, the telephone numbers for LaserFiche, a division of CompuLink Management Center Inc., were listed incorrectly. The correct phone numbers are 800-985-8533 and 310-793-1888.

The Dell PowerEdge 2200 that we tested in our October 21 article "Servers. Cheap." does support RAID Levels 0, 1, and 5.

TV VS. COMPUTERS

Jake Kirchner makes some reasonable statements about children's access to the Internet ("Blow Up Your PC, Move to the Country," October 21) until his last statement, which, for me, nullifies any credibility he may have earned in his column. He concludes with "If we have to start limiting kids' PC usage in the way we do their TV viewing, the loss will be everyone's." What real "loss" would that be? A statement like that presupposes that a kid using a computer is better off than a kid watching TV. For developing young minds, there's good TV and bad TV, and only a truly nurturing, caring, and intelligent parent can tell the difference. Likewise, there is good computer usage and bad computer usage.

SCOTT GREER
Portland, Oregon

KUDOS TO JAKE

I would like to send kudos to Kirchner for his recent articles on protecting children from harmful material on the Internet. I appreciate his honesty and openness, plus his willingness to defend parental rights on this important issue.

TIM STOCKING
via the Internet

FALSE START

It is very disappointing and disturbing to see that writers for your magazine don't even know when the new millennium begins. I find it disgraceful that in a technical magazine, Kirchner is allowed to feed misinformation to the public. In his column "Technology and the Test of Time" (November 4), he claims that the new millennium begins in roughly two years. People should know that the new millennium begins on January 1, 2001.

PAUL BRESKO
via the Internet

I was touched by Kirchner's column "Technology and the Test of Time." His grandmother has seen so much in her lifetime and surely has touched many people. As a fellow baby boomer, I have often pondered what wonders await my children, and so far, I have one granddaughter at work in the field of technology. I'm fairly new to computers (1994), but I follow the

new advances with a sense of wonder. They're moving so fast that it's hard to keep up. Still, I love trying. Unlike many of our generation, I want to be a part of this technological revolution. My best to Kirchner's grandmother. I hope she gets to see the new millennium.

JIM BROOKER
via the Internet

VISIO NOT A FULL PICTURE OF UML

Your comments in the First Looks review "Charts for Nonartists" (November 4, page 62) on Visio Professional's support of the Unified Modeling Language (UML) fail to note what's not present. Currently, only a subset of the semantics for shapes used in static structure diagrams is supported. Shapes for the other diagram types defined by UML are not packaged in the stencils provided. In fairness, UML is a work in progress. I urge your readers not to judge UML's potential by its present limited support from Visio.

DOUG BAIRD
via the Internet

DON'T SPAM THE CHILDREN

The Trends article that discusses junk e-mail and protecting privacy ("Let Consumers Govern the Net," November 4) raises some hopeful solutions. But the Web is lined with sex shops, which are among the most pervasive spammers.

My 8-year-old son recently received an unsolicited e-mail complete with a hot link inviting him to visit someone's sex business. My child's "profile" clearly states that he is 8, but even without this notice, spammers know that many of the addressees within any given list are definitely children. Clearly these sex businesses know that thousands of children are receiving their e-mail advertisements.

We need to have the government make these sex shops accountable for sending their junk mail to children. I appreciate Esther Dyson's proposal of a payment scheme that would raise the cost for e-mailers, but that seems so far down the road. We need simple, effective solutions right now to protect children. At the very least, unless these businesses can find a way to send such e-mail strictly to adult addressees, they should not send it at all.

R. MCCLURE
via the Internet

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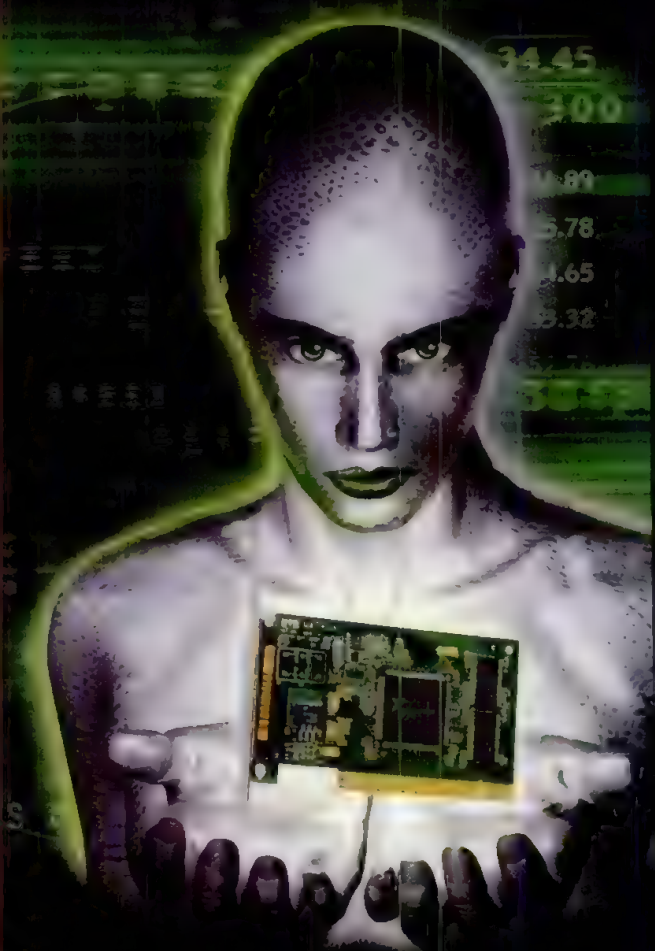


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CIRCLE 122 ON READER SERVICE CARD

Trends

Roll-Up Displays

A flexible plastic display may be headed for your desktop.

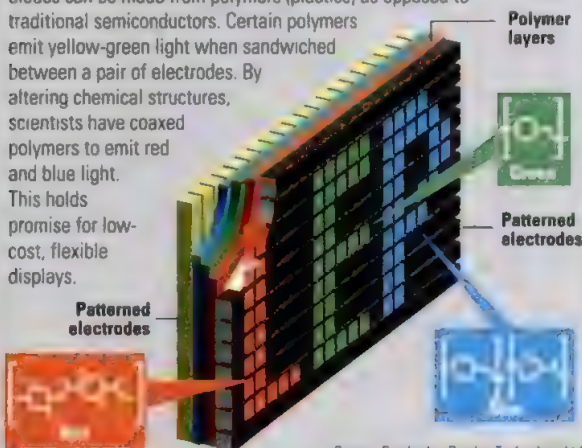
On both sides of the Atlantic in towns called Cambridge, researchers are working on some innovative technologies that could land on your desktop—or your wrist—in the near future.

Let's go first to Cambridge, England, where Cambridge Display Technology (CDT) is taking a radical departure from existing display technology with its flexible plastic panels. CDT holds the worldwide rights for light-emitting polymer (LEP) technology, a potential successor to LCD and CRT technologies.

A team of scientists led by Cambridge University physics professor Richard Friend discovered that light-emitting structures can be made from plastics, as opposed to traditional semiconductors. The researchers found that certain polymers exhibit the properties of semiconductors in that they can support positive and negative charges. According to CDT chief executive officer Danny Chapchal, LEP displays can be thinner, consume less energy, cost less to manufacture, and offer a wider viewing angle than current technology permits.

Electric Plastic

Cambridge Display Technology has discovered that light-emitting diodes can be made from polymers (plastics) as opposed to traditional semiconductors. Certain polymers emit yellow-green light when sandwiched between a pair of electrodes. By altering chemical structures, scientists have coaxed polymers to emit red and blue light. This holds promise for low-cost, flexible displays.



Source: Cambridge Display Technology Ltd

And since manufacturers can construct LEP displays out of flexible plastic, the technology may open the door to a new generation of displays in all shapes and sizes, maybe even roll-up displays. For starters, though, we'll see monochrome alphanumeric displays for watches, cellular phones, and fax machines. Desktop monitors, notebooks, and flat-panel televisions pose greater challenges as to brightness and power efficiency.

An LEP display begins life as a plastic sheet covered with an electrode, explains Carl Pichler, manager of new concepts and intellectual property rights at CDT. Then a thin-film polymer is deposited, followed by a second electrode. Voltage is applied to this plastic sandwich, and a current passes through the polymer layers. "If everything is right, you get light," says Pichler.

One of the key advantages of these displays is power efficiency, since there's no backlight. In addition, manufacturers can cut costs by using inexpensive plastic. And since the display is *emissive*, the viewing angle is 180 degrees.

Engineers at CDT are now working on improving power efficiency, life expectancy, and brightness by experimenting with the

thickness of the polymers. So far, they've focused on coaxing the polymers to emit red and blue light.

Up to now, researchers have produced a simple mobile-phone alphanumeric display that lasts for about 3,000 hours of use. "We can achieve that quite easily right now," says Pichler. The "operating life" for a notebook screen is a different story, however, since the display needs to last for around 20,000 hours of use.

CDT isn't in the business of manufacturing LEP displays. It has licensed the technology to Hoechst, Philips, and an as-of-yet unnamed major Japanese consumer electronics company. Intel recently made a minority investment in the company, joining investors including former Apple CEO John Sculley, former Cable & Wireless chairman Lord Young of Grafton, industry pundit Esther Dyson, and even the rock band Genesis.

MIT'S ELECTRONIC PAPER

Across the Atlantic, in Cambridge, Massachusetts, researchers at the MIT Media Lab are developing *electronic paper*, designed to store an entire book and to display the content using digital ink particles. Led by physicist Joseph Jacobson, the team aims to create a paper-like substance with microencapsulated cells that can rotate. Applying an electrical charge to the capsules changes their orientation so that the same cells can display different images.

Eventually, you'd be able to download books directly from the Web. In the meantime, it's unlikely that any of these display technologies will surpass the convenience of plain old paper anytime soon.—Carol Levin



New Versions of Internet Explorer

Microsoft delivers on its Unix promise.

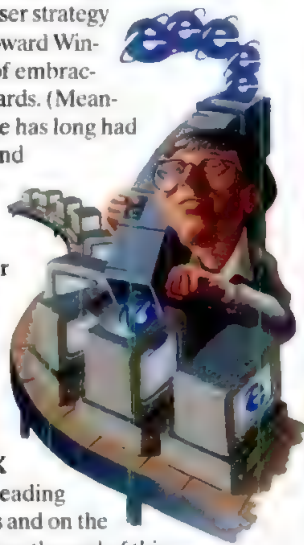
In a move that may help quell charges that Microsoft's Internet Explorer strategy has been Windows-centric and slow to cater to other platforms, the company finally has a preview version of IE 4.0 for Unix. This version, which runs on Sun Solaris, joins the preview releases of IE 4.0 for Macintosh and Windows 3.1.

Microsoft has received much criticism for its failure to deliver IE on platforms other than Windows. Netscape, Oracle, and Sun Microsystems have argued that Microsoft conceived its browser strategy to steer users toward Windows instead of embracing open standards. (Meanwhile, Netscape has long had both Unix and Macintosh versions of its browser.)

In October 1996, Microsoft's Cornelius Willis said, "We will deliver Internet Explorer and ActiveX support on leading Unix platforms and on the Macintosh before the end of this year." That didn't happen. Although Microsoft released a preview version of IE 4.0 for the Macintosh, the Unix version was lagging. Microsoft did deliver what many see as the superior browser for the Macintosh early on, and it was the first to deliver Java on the Macintosh.

"Internet Explorer 4.0 for Unix has been a long time coming for Microsoft," says Yusuf Mehdi, a Microsoft marketing director. "With Internet Explorer 4.0 now available in preview or final form on Macintosh, Windows 3.1, Windows 95, Windows NT 4.0, and Unix, we round out the important pieces of what customers ask in true platform support." According to Craig Beilinson, an IE 4.0 product manager, many of Microsoft's corporate customers have indicated that the absence of a Unix version was holding up their deployment of IE.

Microsoft also plans releases of IE 4.0 for other Unix OSs, including HP-UX, IBM AIX, and SGI IRIX. According to Beilinson, though, "We're not planning browsers for all 31 flavors of Unix operating systems." He adds that international customers have called for more foreign-language support. (Version 4.0 supports over 15 languages.)—*Sebastian Rupley*



Do PC Vendors Take the FCC Seriously?

IN INSIDE PC LABS IN OUR ISSUE OF OCTOBER 21, 1997, we discussed the new FCC rules for emissions testing targeted at computer system vendors. Based on cursory inspection of the systems we received for our December 2 cover story, "The Best PCs for '97 and '98," we discovered mass neglect of the new rules and promised to investigate the matter further. We did, and it turns out that our initial findings were on the mark: There's confusion regarding FCC rules in the PC industry. Many of the vendors, in fact, did not provide proper documentation or properly label their systems.

In mid-1996, the FCC modified its stringent certification procedures: It lets vendors self-test or declare that their products meet FCC emissions requirements or do both.

With the new rules, a system integrator—which builds systems based on third-party components—doesn't need to perform emissions testing but must provide a Declaration of Conformity (DOC) to the FCC, include a copy of the statement in each PC shipped to end users, and place an FCC sticker on the system chassis indicating that the PC is "assembled from tested components." The DOC should list all FCC-approved components, including motherboard, power supply, and any expansion adapters with external cables.

Vendors that design and build their own motherboards are required to perform emissions testing. They can issue DOCs for their systems without listing all components, or they may list everything and

affix labels indicating compliance. Some that perform their own testing go the extra mile and obtain a "Grant of Equipment Authorization" from the FCC and an FCC-ID number.

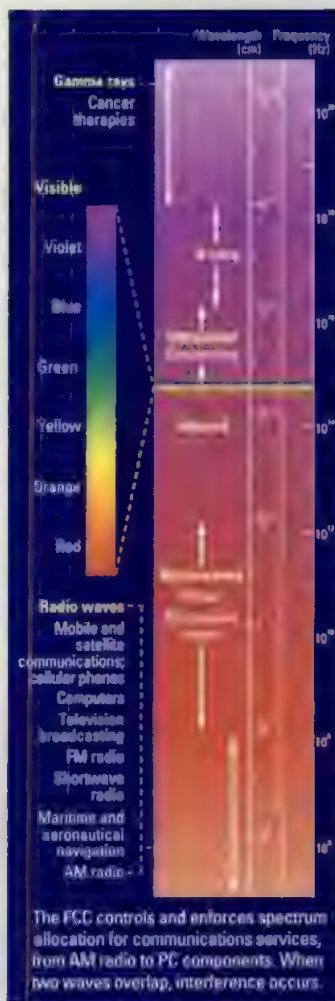
Of the professional/enthusiast systems we received, only 12 had FCC labels, and none came with DOCs. If a system didn't have either an FCC-ID sticker or an FCC label with a corresponding DOC, we called the vendor and requested within one week a copy of its DOC or its FCC-ID. All but 11 vendors—Advanced Megatrends, American Multisystems, Digitron Micro Solution, Duracom, First Computer Systems, Hertz Computer, HiQ Computer, Mega Comput-

er Systems, Nova, Royal, and S.A.G. Electronics—complied with our requests.

The following vendors sent us systems with FCC labels and FCC-IDs: ACMA Computer, IBM, Micro Express, Micron Electronics, NETIS Technology, PC Channel, Premio Computer, Quantex Microsystems, Seanix, and Unicent Technologies. Each of the remaining vendors sent us either a DOC, a Grant of Equipment Authorization (FCC-ID), a copy of its FCC-ID label, or documentation reflecting its interpretation of a DOC.

Since most vendors use third-party components and many don't perform their own testing, we expected to see many DOCs. We didn't. PC vendors should read Section 2.1077 ("Compliance Information") of Title 47 of the Code of Federal Regulations, and they should read Part 2 a little more closely.

—*Nick Stam*



Desperately Seeking a CPU

Windows CE needs a powerful new chip to take it to consumer applications.

With Web televisions and large-screen PCs appearing, computing technology is already converging with home entertainment technology. Now the push is on to bring about a whole new class of PC-based home entertainment systems that can run the new version of Microsoft's operating system Windows CE. The missing ingredient so far has been a microprocessor powerful enough for entertainment and communications applications. Now several players—including Advanced Micro Devices, Digital Semiconductor, Hitachi, and VLSI—are converging on that goal.

Windows CE has been in need of a powerful, multimedia-smart chip to take it beyond the world of hand-held PCs (where sales have been lackluster) and toward the worlds of entertainment and communications. Microsoft

had a big presence at the recent Embedded Systems Conference in San Jose, California, where the company went partly to try to attract semiconductor manufacturers to new chip strategies for Windows CE. The Comdex computer show in Las Vegas also showcased new chips for Windows CE 2.0 applications.

One of the most high-end chips for the operating system is Hitachi's SH-4, which Hitachi America's Jim Venable, director of systems products, describes as "a 64-bit



superscalar processor" that delivers 360 MIPS at a 200-MHz clock speed. If the processor delivers on promises, it will fall roughly in line with the performance of a Pentium Pro chip—well beyond what's cur-

rently available for Windows CE.

VLSI Technology has also produced the Hitachi SH-4 chip, in a system-on-a-chip strategy built around a PCI bus and the new version of Windows CE. Hitachi and VLSI foresee a 20-million-unit-a-year home entertainment system (HES) market built around this new platform by the turn of the century. Manufacturers will show the first HES units in early 1998.

Other chip makers are taking aim at high-end consumer applications for the new version of Windows CE as well. Microsoft is translating the new version of Windows CE to Advanced Micro Devices' 486-level Elan chip, and Digital Semiconductor has a 200-MHz StrongARM CPU for Windows CE applications.

Harel Kodesh, general manager of the consumer appliance group at Microsoft, says 1998 will bring Windows CE to "diverse consumer markets." That depends, though, on the arrival and acceptance of the right processor.—*Sebastian Rupley*

JAKE KIRCHNER

Bugged by the Year 2000

Don't you hate it when people start the new year by talking about "the year ahead" or "the year just ended"? I'm going to spare my readers that torture and instead talk about *two* years from now. Specifically, this is about the year 2000. It's also about hate.

The reason the two are related in my mind at the moment is a recent letter I got after one of my previous columns talked about celebrating the new millennium on January 1, 2000. "I really hate it," my correspondent wrote, "when supposedly educated people like yourself don't understand that the new millennium doesn't start until 1/1/2001."

Well, I don't mind getting dinged now and then by my readers. We all know that everyone hates journalists to begin with. Not that we're among a particularly select group here, because of course we all know that "everyone hates" bankers and politicians and insurance companies and Wall Street wise guys, and traffic cops with radar guns, and on and on. And don't get me started on the airlines with their skyrocketing rates and cramped planes and bad or nonexistent food even on long flights!

As for the year 2000, well, I just hate it when people take things so seriously. I know that logically the millennium can't begin until 1/1/2001, because, after all—the argument goes—there wasn't a year 0, was there? But I say the current method of counting years is just a polite social fiction designed centuries ago to keep us all on the same page. For all we know, it's really been 2,003 years since Christ's birth. More importantly, I do know that the few people who stubbornly hold out until 1/1/2001 are going to miss one hellacious



party that will start early on the evening of 12/31/1999. Serves 'em right, too.

But if there's a good reason to think of the year 2000 with dread, it's the Year 2000 bug, which hits when millions of software programs can't identify 1/1/00 as the first day of the year 2000 instead of the first day of the year 1900. At that point, systems will crash, commerce will come to a standstill, and the Dow Jones Industrial Average will drop at least 3 or 4 points.

After spending hundreds of billions a year for generations on computer hardware and software, now we're told much of it will stop working in two years unless we pour an estimated half-trillion dollars more into the bank accounts of assorted programmers, consultants, and software vendors, who stand ready to fix the problem they caused in the first place.

This is not going to go over well. Until now the computer industry has survived with nary a blemish buggy chips, untested software, nonexistent technical support, rapacious shrink-wrap warranties, and exploding laptop batteries. No more. This Year 2000 fiasco is going to sink the reputations of everyone having anything to do with computing, adding all of us to the "everyone hates" list.

Personally I think that we should insist that the vendors fix this problem for free. But then, if this Year 2000 bug hits the fan as warned, the money that will be generated right and left by lawsuits will dwarf the few hundreds of billions spent fixing the nation's software.

Of course, most of that money will end up in the pockets of attorneys. Geez, don't you just hate attorneys!

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Versa 6230

- 233MHz Pentium processor with MMX technology
- 13.3" XGA Active Matrix TFT Color Display
- 32MB EDO DRAM (128MB max)
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- 4.3GB Ultra DMA Hard Drive
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- Altec Lansing ACS-90 Speakers
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- * Upgrade to 64MB SDRAM Memory, add \$199
- * Upgrade to 6.4GB Ultra DMA Hard Drive, add \$99
- * Upgrade to NEC C700 17" Monitor (16" viewable), add \$219
- * Upgrade to DirecPC Satellite, add \$299

Direction SPT233

- 233MHz Pentium processor with MMX technology
- 32MB SDRAM Memory
- 3.2GB Ultra DMA Hard Drive
- NEC C550 15" Monitor (14" viewable)
- Number Nine Reality 334 4MB SGRAM PCI Video Card
- Altec Lansing ACS-90 Speakers
- * Upgrade to Creative Labs AWE32 Wavetable, add \$49
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DESKTOP PCS

Pentium IIs for 2K!

Though the Pentium Processor with MMX Technology still commands much of the desktop market, its successor, the Pentium II, has undoubtedly reached the mainstream. After debuting this past May in the \$3,500 to \$5,000 range, Pentium II systems are now available for little more—and in some cases a little less—than \$2,000. Even the 300-MHz Pentium II ("The Two Faces of 300-MHz," September 23, 1997), marketed as a high-end workstation chip at its arrival last August, has become an affordable option.

Through Dell Computer Corp. (800-388-8542, www.dell.com), you can now purchase a Pentium II desktop for less than \$2,000. The **Dell Dimension XPS D233**—a 233-MHz system equipped with 32MB of SDRAM memory, a 4.3GB UltraATA hard disk,

an STB Velocity card (with 4MB of SGRAM), and a 24X max CD-ROM drive—sells for \$1,999 (all prices are direct). The company includes, at no extra cost, a 15-inch Trinitron monitor (with a 13.7-inch viewable area), two Altec Lansing speakers, and Microsoft's Home Essentials 97 bundle. The 266-MHz **Dell Dimension XPS D266** and the 300-MHz **Dell Dimension XPS D300** (64MB of SDRAM) begin at \$2,111 and \$2,509, respectively.

Gateway 2000 (800-846-2000, www.gateway.com), second only to Dell in direct PC sales, has announced its own \$1,999 Pentium II



CHEAP SPEED: The 300-MHz NEC Direction SPL300 costs \$2,199.

desktop. The 233-MHz **Gateway G6-233 Best Buy** offers only 2GB of hard disk storage, but it includes a 17-inch monitor (with a 15.7-inch viewable area) and a 56-Kbps x2 modem. Outfitted with 32MB of SDRAM memory, an STB nVidia AGP card (4MB of SGRAM), and Altec Lansing ACS-41 speakers, the system's hardware is otherwise similar to that of the Dell PC. Gateway also provides several software titles (including Microsoft Encarta, Microsoft Works, Microsoft Money, and Quicken SE). With a 15-inch monitor, the system sells for \$1,799. The company also sells a 266-MHz model with the same

same basic specs, for \$2,414 (\$2,313 with a 15-inch monitor). The cost of upgrading to a 4GB hard disk on each of these machines is only \$85.

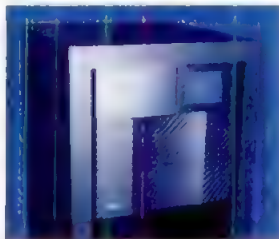
The most impressive Pentium II offering, for the moment, comes from NEC Computer Systems Division (888-306-4636, www.nec-computers.com), which is a newcomer to the direct market. The **NEC Direction SPL300**—a 300-MHz Pentium II desktop system featuring 32MB of SDRAM memory, a 4.3GB UltraATA hard disk, a Number Nine AGP card (with 4MB of SGRAM), a 24X max CD-ROM drive, and two Altec Lansing speakers—now costs \$2,199. Like the Dell, the Direction ships standard with a 15-inch monitor and the Microsoft Office 97 Small Business Edition. And like the Gateway, it ships standard with a 56.6-Kbps x2 modem.—Cade Metz

RECAP PC Magazine tested 97 PCs in our issue of December 2, 1997. The Dell Dimension XPS D266 and the NEC Direction SPL266 won Editors' Choices.

SERVERS

Pentium Pro Proliferates

The Pentium Pro may have lost its influence on the desktop, but its role in the server market continues to escalate. After eight-way Pentium Pro technology announcements from Corollary and NCR (TrendsPCs, "By Sixes and Eights," April 22, 1997) and a ten-way Unisys Corp. announcement (TrendsPCs "The Ten-Way Pentium Pro Debuts," June 24, 1997), Axil Computer (800-284-2945, www.axil.com) recently debuted



HARD EIGHT: The Northbridge NX803 supports eight Pentium Pros.

the **Northbridge NX803**, an eight-way rack-mountable SMP Pentium Pro server designed specifically for resellers.

The NX803 supports up to eight 200-MHz Pentium Pro

processors (512K or 1MB secondary cache) and up to 8GB of SDRAM while providing 16 PCI slots, 2 ISA slots, an UltraSCSI port, integrated Fast Ethernet, and 2 USB ports. Axil also supplies hotswappable N+1 power supplies, fans, and hot-pluggable disks.

The system's base price (sans processors, memory, and disks) is \$18,000. The prices of additional components will vary from reseller to reseller, but you should expect a full complement of memory, disk drives, and processors to be an additional \$20,000 to \$50,000. Since its processors are installed on removable modules, the system will also accommodate Intel's forthcoming Deschutes chip.—CM

One More Monoputer

The rise of the LCD desktop continues. Following last year's product announcements from Compaq, All Computer Technology, and Monorail (TrendsPCs, "The Return of the Monoputer," February 2, 1997), Hitachi has introduced its own so-called all-in-one LCD desktop: the VisionDesk. This 22-pound unit, priced from \$3,300 to \$3,600 on the street, is a standard MMX Pentium system with an integrated 13.3-inch active-matrix panel, much like those used by Hitachi notebooks.

Though one-third the size of a standard desktop machine, the VisionDesk is a complete solution, providing a 233-MHz processor,



ALL-IN-ONE: The 22-pound VisionDesk has a 13.3-inch LCD monitor.

512K of secondary cache, a 4.3GB hard disk, a 20X max CD-ROM drive, integrated stereo speakers, a 56.6-Kbps x2 modem, and 10/100 Ethernet. Like most of today's laptops, it also integrates an infrared port for wireless data transfers to printers, digital cameras, and PDAs.

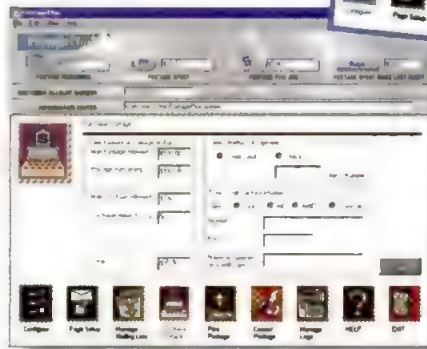
Optimal for cramped corporate environments, the unit is DMI-2.0 compliant and supports Intel's LAN-Disk Client Manager 3.1, a means of remote inventory and monitoring.—CM

POSTAGE SOFTWARE

No More Stamps?

Mail meters—those hardware devices that stamp your letters and take up space on your desk—may start to become a thing of the past this year. And you may end up making fewer trips to the post office, thanks to new software that lets you download postage and mail letters directly from your PC.

Pitney Bowes (800-640-7058, www.pitneybowes.com), long known for its mail meters, has ventured into the software arena with **Personal Post Office for the PC**. The company expects the product to ship in the middle of this year; pricing has yet to be determined. With Personal Post Office, you can download postage from either the Internet or a direct network connection to Pitney Bowes' secure



Postage by Phone system. You can then have the postage printed onto labels or envelopes with any laser, ink-jet, or bubble-jet printer. And because it can determine the exact up-to-date rate, the software prevents you from paying too much or too little postage.

Personal Post Office will allow users to manage multiple address books, import and export existing



SIGNED, SEALED, AND DELIVERED:
Saranac Software's PostagePlus.

PC lists that are of any ODBC-compliant file type, verify addresses, and design envelopes. In addition, the product lets you customize your billing functions, track and control mail costs (especially larger-volume direct mailings), and—by way of a secure encryption feature—print envelopes with both addresses and proof-of-postage marks. A Postal Security Device (PSD)—a small piece of hardware that will come with the software—enhances the system's security.

At press time, Pitney Bowes is awaiting approval from the United States Postal Service (USPS) to market its postage software.

Like Personal Post Office, **PostagePlus**, from Saranac Software (315-471-3123, www.postageplus.com), is awaiting USPS approval. PostagePlus, which is due out the second half of 1998, is tentatively priced to include a \$30 registration fee plus \$5 to \$10 per month (in addition to normal postage costs). The software has an address-correction feature and allows you to print postage exclusively from the Internet onto labels or envelopes using any 300-dpi printer or greater; no additional hardware is required.

PostagePlus also lets you launch the program from within Microsoft Word—a convenient feature for mail-merges. It also supports mail-merge address lists from Symantec's ACT! and Microsoft Access. PostagePlus provides refunds for returned letters and other such situations. And like Personal Post Office for the PC, PostagePlus includes mail tracking and allows for secure transactions via a two-way authentication system.—Yvonne Koulouthros

DVD REFERENCES

More for Your Money

Slowly but surely, DVD software is making its way to store shelves. Microsoft Corp. (800-426-9400, www.encarta.msn.com), Grolier Interactive (203-797-3530, gi.grolier.com), and Xiphias (310-841-2790) each have products in the pipeline.

First out the gate is Microsoft's Encarta DVD-ROM Reference Suite 98 (\$130 street). Thanks to the expanded capacity of DVD-ROM, Microsoft can bundle on one disk Encarta 98 Encyclopedia Deluxe Edition, Encarta Virtual Globe 1998 Edition, and Book-

shelf 98 (essentially the equivalent of five CD-ROMs). Each product has been retooled and enhanced to capitalize on DVD.

Encarta's content has been updated to include 6,000 new articles with 900 sidebars, 20 new InterActivities, a new Research Organizer, and better search tools. Virtual Globe adds over 6,000 articles, 10,000 Web links, and more detailed maps, while Bookshelf improves upon its QuickShelf and QuickFootnote features.

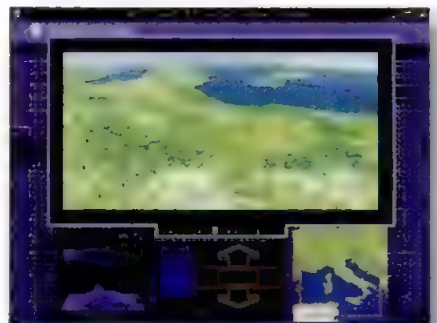
Exclusive to the DVD version of Encarta are 33 panoramic 360-degree views from around the world; this more than doubles the number of panoramas in the CD-ROM version. Meanwhile, the Virtual Globe not only adds more detail to its maps (which let you locate over 1.2 million places) but also makes available enhanced data that allows you to

zoom in to 1,000 kilometers when viewing the 19 different map styles. Also new to Virtual Globe are four new 3-D World Flights, which allow you to experience the thrill of flying over some unique geographic landmarks.

Next on deck is Grolier's new Grolier Multimedia Encyclopedia 1998 Deluxe DVD-ROM Edition (due in the first quarter of this year). Building on the solid content foundation set in place by the CD-ROM encyclopedia, the DVD-ROM edition adds MPEG2 videos for full-frame, full-motion video. MIDI sound is replaced by AC3 audio; in addition to new sound clips, there's nearly 13 hours of stereo-quality digital music, including full orchestral performances of pieces from such varying genres as classical, jazz, and world music.

Finally, Xiphias Corp. is offer-

ing the \$65 Encyclopedia Electronica. This DVD-ROM volume features over 25,000 encyclopedia articles and 15,000 stories. The disk excels in its



UP CLOSE: Detail afforded by Encarta Virtual Globe in Microsoft's DVD reference suite.

presentation of multimedia content, which encompasses over 80 minutes of MPEG-2 video, 8,400 still images, and 30 panoramic views. There are four separate views for searching the program's content, and you can keep records of relevant returned results to your searches.—Melissa J. Perenson

RECAP PC Magazine reviewed seven CD-ROM encyclopedias in the issue of December 16, 1997. An Editors' Choice was awarded to IBM's World Book 1998 Multimedia Encyclopedia and Encyclopaedia Britannica's Britannica CD 98 Multimedia Edition.

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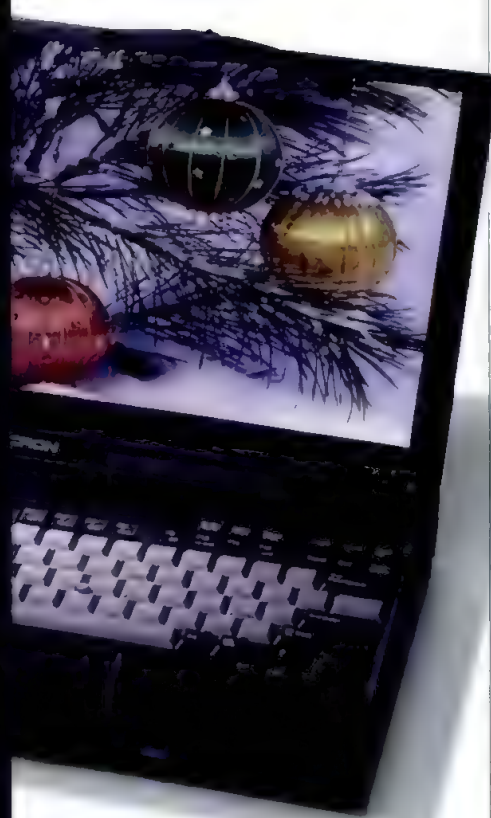


When you need more portable power, the Micron TransPort product team charges ahead with (clockwise from bottom left): Julia, Drew, Bill, Jeff, Jeff, Andrew and Kim.



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Micron's workstation team makes sure your needs are covered. So the Powerdigm workstation supports dual monitors, dual Pentium II processors, multiple ultra-wide SCSI-3 hard drives and 10/100 network adapters. The Fire GL video cards offers no-compromise 3D performance and Jaz drives are standard on both the XSU and XLI Powerdigm models.

It's also hard to beat the industry-leading Micron PowerSM limited warranty and our award-winning customer service and support. Call today and find out more about the Powerdigm XSU and XLI workstations.



Business Solutions

Configurations

NetFRAME® LV2000

Intel 233MHz Pentium II processor
ECC Level 2 cache on processor
32MB ECC SDRAM
2GB Ultra-Wide SCSI-3 hard drive
Microsoft® Windows NT® Server 4.0 (10-user license)
Intel LANDesk® Server Manager 2.8
NOS Support (3 incident resolutions/1st year), 7x24

STANDARD FEATURES

Single or dual Intel Pentium® II processors
512KB integrated cache in SEC package
ECC SDRAM option (4 DIMM slots)
5 expansion slots: 4 PCI, 1 ISA
Integrated Adaptec PCI Ultra Wide SCSI-3 controller
Integrated Intel EtherExpress™ Pro 100 controller
12X SCSI-2 CD-ROM drive
10 drive bays: 4 external 5.25"/1 external 3.5"
2 internal 5.25"/3 internal 3.5"
Dedicated server technical support, 7x24
5-year/3-year Micron PowerSM limited warranty
1-year next-business-day on-site service***

\$3,499

Bus. Lease \$119/mo.

NetFRAME MV5000

Intel 300MHz Pentium II processor
ECC Level 2 cache on processor
64MB ECC SDRAM
4GB Ultra-Wide SCSI-3 hard drive
Microsoft Windows NT Server 4.0 (10-user license)
NOS Support (3 incident resolutions/1st year), 7x24

STANDARD FEATURES

Single or dual Intel Pentium II processors
512KB integrated cache in SEC package
Memory: ECC EDO or ECC SDRAM option
9 expansion slots: 6 PCI, 2 ISA, 1 shared ISA/PCI
Dual integrated Symbios Ultra-Wide SCSI-3 controller
Integrated Symbios Narrow SCSI controllers
Embedded RAID Upgrade option
I2O ready via embedded Intel i960-RD
5 Internal, hot-pluggable, hard drive array bays (Upgradable to 10)
1 (one) 360 watt hot-pluggable power supply standard
(Upgradable to 3 for added redundancy)
Rack Adapter Option
Intel LANDesk Server Manager 2.8
Dedicated server technical support, 7x24
5-year/3-year Micron PowerSM limited warranty
1-year next-business-day on-site service***

\$5,699

Bus. Lease \$181/mo.

ClientPro® VXE

Intel 166MHz Pentium processor with MMX™ technology
32MB EDO RAM, support for SDRAM
1.2GB SMART EIDE hard drive
15" Micron 500Lx, .28dp (13.7" display)

512KB pipeline burst cache, flash BIOS, DMI 2.0
3Com 3C509 ISA Ethernet T-P NIC
16X EIDE variable speed CD-ROM drive
S3 ViRGE graphics accelerator, 2MB EDO RAM
Microsoft Mouse
Microsoft Windows® 95
5-year/3-year Micron Power limited warranty

\$1,399

Bus. Lease \$49/mo.

ClientPro MRE

Intel 200MHz Pentium processor with MMX technology
64MB SDRAM
2.1GB Ultra ATA SMART EIDE hard drive
15" Micron 500Lx, .28dp (13.7" display)

512KB pipeline burst cache, flash BIOS, DMI 2.0
Network Adapter with Wake On LAN technology
16X EIDE variable speed CD-ROM drive
S3 ViRGE graphics accelerator, 2MB EDO RAM
Intel LANDesk Client Manager
Advanced hardware monitoring and power management features
Chassis intrusion alert
Microsoft IntelliMouse
Microsoft Windows 95
5-year/3-year Micron Power limited warranty

\$1,699

Bus. Lease \$59/mo.

ClientPro XLU

Intel 266MHz Pentium II processor with MMX technology
64MB EDO RAM
2.1GB SMART EIDE hard drive
17" Micron 700FGx, .28dp (16" display)

512KB internal L2 secondary cache, DMI support
3Com PCI 10/100 ethernet NIC
16X EIDE variable speed CD-ROM drive
PCI 64-bit 3D video, MPEG, 4MB EDO RAM
Upgradable wavetable audio with speakers
Microsoft IntelliMouse™
Microsoft Windows NT Workstation
Intel LANDesk Client Manager
5-year/3-year Micron Power limited warranty

\$2,499

Bus. Lease \$85/mo.

***On-site service for NetFRAME LV2000 and MV5000 server is provided by Digital Equipment Corporation and is optional.

Call now to order.
888-224-4151
www.micronpc.com



Configured for Your Life™

Portable Solutions

System Configurations

Micron TransPort™ VLX

166MHz Intel Pentium processor with MMX technology
24MB EDO RAM (40MB max.)
2.1GB hard drive
16X modular CD-ROM drive
Li-Ion battery
3Com US Robotics 56Kbps modem
12.1" TFT SVGA, 800x600 display
256KB L2 pipeline burst cache
PCI bus with 128-bit graphics accelerator
MPEG compatible
Zoomed video-ready
Touchpad pointing device
Microphone and 16-bit stereo sound
2-way infrared port
Microsoft Windows 95 and MS Plus!
Modular floppy drive
5-year/1-year Micron limited warranty

\$2,499

Bus. Lease \$87/mo.

Micron TransPort XKE

STANDARD FEATURES

512KB pipeline burst cache
128-bit, 2MB DRAM graphics
20X modular CD-ROM drive with AutoPlay™ technology
Pick-a-Point dual pointing devices
Microphone and 16-bit stereo sound
Integrated 33.6 Kbps modem (upgradable to 56Kbps), full duplex, CardBus- and Zoomed Video ready
2 infrared ports, S-Video, NTSC, game and USB ports
Management and Executive Travel software pak
2 modular expansion bays
Dragon System NaturallySpeaking Personal voice recognition software
Custom nylon carrying case
Microsoft Windows 95 and MS Plus!
Microsoft Office 97 Small Business Edition
5-year/3-year Micron Power limited warranty

Extended VLX Portable Service Options

2nd and 3rd year parts and labor; 3-business-day turnaround for 3 years¹	\$269
2nd and 3rd year parts and labor; 7-business-day turnaround for 3 years¹	\$209

Micron TransPort XKE 166

166MHz Mobile Intel Pentium processor with MMX technology
32MB EDO RAM
1.6GB removable hard drive
12.1" TFT SVGA display

\$3,499

Bus. Lease \$119/mo.

Micron TransPort XKE 200

200MHz Mobile Intel Pentium processor with MMX technology
48MB EDO RAM
2.1GB removable hard drive
13.3" TFT XGA display

\$4,199

Bus. Lease \$133/mo.

TransPort Options

Micron Executive™ desktop package: matching black 17" monitor (15.8" display), mouse, mousepad and keyboard (can be used with or without MicronDock. Available on XKE models only.)	\$599
Leather carrying case upgrade	\$99

Micron TransPort XKE 233

233MHz Mobile Intel Pentium processor with MMX technology
64MB EDO RAM
5GB removable hard drive
13.3" TFT XGA display

\$4,999

Bus. Lease \$158/mo.

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Configured For Your Life™

Performance Desktop Solutions

Millennia® MME

STANDARD FEATURES

512KB pipeline burst cache, flash BIOS
Integrated 100MB Iomega Zip drive, 3.5" floppy drive
24X variable speed EIDE CD-ROM drive
32 voice wavetable stereo sound with speakers
USR Sportster 56K x2 data/fax modem*
PCI 64-bit 3D video, MPEG, 4MB EDO DRAM
Microsoft® IntelliMouse™, USB connections
Microsoft Windows® 95 and MS® Plus!
Microsoft Office 97 Small Business Edition
Choice of Micron Software Solutions Pak
5-year/3 year Micron Power™ limited warranty

Millennia MME 166

Intel 166MHz Pentium® processor with MMX™ technology
32MB SDRAM
3.2GB Ultra ATA hard drive
15" Micron 500FGx, .28dp
(13.7" display)

\$1,599

Bus. Lease \$55/mo.

Millennia MME 200

Intel 200MHz Pentium processor with MMX technology
64MB SDRAM
4GB Ultra ATA hard drive
17" Micron 700FGx, .26dp
(16" display)

\$2,099

Bus. Lease \$72/mo.

Millennia MME 233

Intel 233MHz Pentium processor with MMX technology
64MB SDRAM
6.4GB Ultra ATA hard drive
17" Micron 700FGx, .26dp
(16" display)

\$2,299

Bus. Lease \$79/mo.

Micron Software Solutions Paks

Quicken Financial Pak: Quicken Deluxe, Family Lawyer, Parents' Guide to Money, Financial Planner†

EdVenture Pak: Comprised of exciting children's educational and entertainment titles. Call for current list of titles.†

Home Productivity Pak: Creative Multimedia's Family Doctor, Comptons Interactive Encyclopedia, Mindscape's Mavis Beacon Teaches Typing, Broderbund's PrintShop Ensemble III, Net Nanny, Crayola's Magic 3D Coloring Book†

Arcade Pak: X-wing vs. Tie Fighter, Need For Speed 2, Command and Conquer Red Alert, Thrustmaster Game Pad†

Millennia XKU

STANDARD FEATURES

82440LX chip set
512KB internal L2 cache, 2MB BIOS
Integrated 100MB Iomega Zip drive, 3.5" floppy drive
24X EIDE variable speed CD-ROM drive
32 voice wavetable stereo sound with Advent 009 speakers with subwoofer
USR Sportster 56K x2 data/fax modem*
Diamond Viper V330 128-bit 3D video with 4MB SGRAM
Microsoft IntelliMouse, USB connections
Microsoft Windows 95 and MS Plus!
Microsoft Office 97 Small Business Edition
Choice of Micron Software Solutions Pak
5-year/3 year Micron Power limited warranty

Millennia XKU 266

Intel 266MHz Pentium II processor
(features MMX technology)
64MB SDRAM
6.4GB Ultra ATA hard drive
17" Micron 700FGx, .26dp
(16" display)

\$2,599

Bus. Lease \$89/mo.

Millennia XKU 300

Intel 300MHz Pentium II processor
(features MMX technology)
128MB SDRAM
8.4GB Ultra ATA hard drive
17" Micron 700FGx, .26dp
(16" display)

\$3,099

Bus. Lease \$106/mo.

Fusion 3D Option Pak

DVD-ROM, **DVD software
E4 Cool DVD PCI decoder card: 6 channel AC-3 to 2 channel out capability, SPDIF output (digital audio out)
AWE 64 ISA sound card
Cambridge SoundWorks/MicroWorks - 2 speaker satellite with subwoofer stereo system
Monster 3D graphics card with 4MB memory***
Fusion 3D game pak: Mech Warrior 2: Mercenaries D3D version, AH-64D Longbow, U.S. Navy Fighters '97, Command & Conquer, Formula 1 D3D Edition
MS Sidewinder™ Pro Joystick

MME add \$699

XKU add \$549

*Maximum transmission speed of up to 56Kbps when downloading data and 33.6Kbps when uploading. However, actual performance is dependent upon numerous factors and observed transfer rates may be less than the maximum potentials.

**The CD-ROM drive will be removed upon the purchase of the DVD upgrade.

***Available only on Millennia MME system.



Workstation Solutions

Powerdigm™

STANDARD FEATURES

Samurai™ chip set
4GB Ultra-Wide SCSI-3 hard drive
12/20X variable speed SCSI CD-ROM drive
Supports IDE Ultra ATA and multiple Ultra-Wide SCSI-3 hard drives
DMI, software and hardware management support
Iomega Jaz SCSI drive with 1GB removable cartridge
Wavetable stereo sound with speakers
3Com Fast EtherNet 10/100 PCI network adapter
Microsoft® IntelliMouse™
Microsoft Windows NT® Workstation
5-year/3 year Micron Power™ limited warranty

Powerdigm Xsu

Intel 300MHz Pentium II processor
64MB ECC SDRAM
Memory upgradable to 1GB ECC SDRAM
19" Hitachi SuperScan CM751
(18" display) .26dp monitor
Fire GL 1000 pro 8MB
66MHz PCI Open GL

\$4,699

Bus. Lease \$149/mo.

Powerdigm Xsu

Dual Intel 300MHz Pentium II processors
128MB ECC SDRAM
Memory upgradable to 1GB ECC SDRAM
21" Hitachi SuperScan CM801
(20" display) .26dp monitor
Fire GL 4000 15MB
3DRAM/16MB CDRAM

\$8,308

Bus. Lease \$263/mo.



Call our sales team today! Left to right: Felice, Brian, Fred, Justin, Bruce and Ron.



Other Systems Options

Multimedia Options

32 voice wavetable stereo sound card	\$59
32 voice wavetable stereo sound card with 2MB RAM	\$99
Advent AV270 Powered Partners stereo speakers	\$79
Advent AV370 Powered Partners stereo speakers with subwoofer	\$199
Microsoft SideWinder™ 3D Pro joystick	\$59
Microsoft SideWinder gamepad	\$39

Storage/Media Options

Adaptec 2940U Ultra SCSI Fast-20 controller (upgrade from system with standard Ultra SCSI Fast-10 controller)	\$100
Plextor 12/20 Plex 3MB/sec SCSI internal CD-ROM drive (upgrade from system with standard EIDE CD-ROM drive)	\$100
Iomega Jaz SCSI drive with 1GB removable cartridge	\$299
Iomega Zip IDE drive with 100MB removable cartridge	\$99
Iomega 6-pack of 100MB Zip cartridges	\$99
Sony 4/8GB SCSI DDS-2 tape backup drive with tape and software	\$899
Seagate TR4 IDE 4/8GB tape backup with tape and software	\$239
Seagate TR4 SCSI 4/8GB tape backup with tape and software	\$279
Cheyenne ARCserver with InocuLAN	\$499

Display/Video Options

17" Hitachi SuperScan CM630 (15.9" display) .26dp color monitor	\$100
19" Hitachi SuperScan CM751 (18" display) .26dp color monitor	\$300
21" Hitachi SuperScan CM801 (20.0" display) .26dp color monitor	\$650
Number Nine Imagine 128 series II video card, 4MB VRAM	\$299
Number Nine Imagine 128 series II video card, 8MB VRAM	\$549

Printer Options

HP Deskjet 692C	\$269
HP Deskjet 890Cn	\$429
HP LaserJet 6Lx	\$399
Lexmark 1000 Color Jetprinter	\$140
Lexmark 2030 Color Jetprinter	\$179
Lexmark 7200 Color Jetprinter	\$399
Lexmark Optra E+ Laser printer	\$399
Epson Stylus Color 600	\$269
Epson Stylus Color 800	\$399
Canon BJC - 80	\$299
Canon BJC - 250	\$149
Canon BJC - 4300	\$199
10ft. IEEE-1284 Printer Cable	\$ 16

Communication Options

33.6 external data/fax modem	\$299
56Kbps technology modem* upgrade	\$99

Server Extended Service Options

2nd and 3rd year next-business-day on-site service coverage	\$99
4-hour response on-site service coverage (8am - 5pm, M-F), 3 year	\$798
4-hour response on-site service coverage (24 hours, 7 days per week), 3 year	\$998
Other service options may be available, ask your system consultant	

Extended Desktop Service Options

Optional 1st year on-site service coverage included	
2nd year on-site service coverage	\$79
2nd and 3rd year on-site service coverage	\$99
Other service options may be available, ask your system consultant	

Software Options

Small Business Essentials: QuickBooks, Visio, Norton AntiVirus, Astound, Focal Point, American Yellow Pages	\$179
CorelDRAW 7 (full retail version)	\$299
Corel WebMaster Suite (full retail version)	\$99

Network Options

3Com 3C509B Etherlink III ISA combo network adapter	\$79
3Com 3C905 EtherlinkXL PCI combo network adapter	\$99
3Com OfficeConnect Hub 8/TCP	\$149
3Com OfficeConnect Switch 140	\$969

Other Options

APC Per/T surge suppressor	\$39
APC Pro/T surge suppressor	\$59
Microsoft Natural Keyboard (upgrade from standard keyboard)	\$49

* Requires SCSI host adapter
* Upgrade from systems with standard Micron 17" 17FG color monitor
* 1st year on-site service is available in the United States and in limited areas in Canada from third-party service providers per customer's agreement with provider
* 2nd year and 3rd year offerings are available in the United States only. Extended services, if purchased after system shipment may have a higher cost.
* Service will be scheduled whenever possible, for the next business day after parts are received by the customer
* Available in certain locations, ask your system consultant for details
Some options and accessories available with system purchase only

* Maximum transmission speed of up to 56Kbps when downloading data and 33.6Kbps when uploading. However, actual performance is dependent upon numerous factors and observed transfer rates may be less than the maximum potentials.

Available only on Millennia systems with Microsoft Windows 95

MICRON POWER WARRANTY

5-year limited warranty on microprocessor and main memory
3-year limited parts-only system warranty (1-year for Transport W.L.)
1, 2 or 3-year optional on-site service agreement for Micron desktop and server systems
30 days of free Micron-supplied software support for Micron desktop systems, 3 optional network operating system (optional) resolutions included for Micron server systems
30-day money back policy
24-hour technical support
The foregoing is subject to and qualified by Micron's standard limited warranties and terms and conditions of sale. Terms and conditions of sale may vary by specific configurations. Copies of the limited warranties may be obtained on our Web site or by calling Micron.

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Trends Peripherals

MASS STORAGE

Store More, Find It Faster

As long as software applications and Internet downloads keep getting bigger and bigger, manufacturers will keep pumping out larger and faster hard disks. The newest entries from the major industry players show that this trend is not stopping anytime soon. As a result, the price per megabyte of storage keeps on dropping.

Seagate Technology (408-438-6550, www.seagate.com) has recently come out with a brand-new entry in its Medalist line of IDE hard disks. The **Medalist Pro 9140** (\$500 street price) is a 9.1GB Ultra-ATA disk with a transfer rate of 33 MBps and a spin rate of 7,200 rpm. This four-platter disk ships with an installation poster as well as Seagate's DiscWizard, which helps make a system with an old BIOS function with a large-capacity disk. On the bottom of the Medalist Pro is the company's SeaShield, which protects the inner workings of the disk from puncture, dust, and heat.

The 9.1GB **WD Enterprise**, a high-end SCSI model from Western Digital Corp. (714-932-4900, www.wdc.com), is a six-platter Ultra-SCSI disk with a 7,200-rpm spin rate and an average seek time of 8 ms. Data throughput is enhanced with the company's Serpentine Seek Technology, which is intended to reduce the drag associated with actuator movement. The disk costs \$1,050 (list price) with a 512K multisegmented data buffer and \$1,070 (list price) with a 1MB buffer.

Joining the fray is Quantum Corp., whose new line of **Bigfoot TX** disks is targeted at the consumer and SOHO market (408-894-4000, www.quantum.com). Each member of the line conforms to the 33-MBps Ultra-ATA specification and comes with S.M.A.R.T. data protection technology. The line ranges

from 4GB to 12GB; the entry-level 4GB model costs \$209 (list price), while the 12GB model costs \$399 (list price).

Also in pursuit of home and business users is Maxtor Corp. (800-262-9867, www.maxtor.com). The company's **DiamondMax 2160** series conforms to the Ultra-ATA specification, and models range in size from 3.5GB to 8.4GB. Compliant with the power-saving EPA Energy Star "Green PC" standards, the disks each come with installation cables, an illustrated guide, and the company's own MaxBlast, an installation software package. The baseline 3.5GB model sells for \$199 (list price), while the 8.4GB model has a list price of \$499.

For servers, Seagate's latest entry in its Cheetah line of high-end SCSI disks is the **Cheetah 9LP/18** (\$1,755 list price). An 18.2GB disk that spins at 10,000

rpm, the Cheetah boasts transfer rates of over 21 MBps. It's a six-platter model with seek times ranging from 5.2 to 5.7 ms. The disk is also available in a Fibre Channel version.

IBM Corp. (800-426-7777, www.ibm.com/storage) steps into the 10,000-rpm game with

that is designed to help network administrators monitor system temperature more easily.

IBM is also offering its 9.1GB **Ultrastar 9ES** drive for \$900 (list price). This five-platter Ultra-SCSI unit spins at 7,200 rpm. The disk has an average seek time of 7.5 ms, and it comes with integrated S.M.A.R.T. technology. Also integrated into the Ultrastar 9ES is IBM's MRX advanced head technology, which increases areal density and reduces the number of disks and heads required for a given capacity. The disk also comes with a 512K data buffer.

Also targeted at the high-end server market is IBM's new **Ultrastar 18XP**. An 18.2GB Ultra-SCSI disk with ten platters, the Ultrastar 18XP spins at 7,200 rpm and has a 40-MBps transfer rate. Its smaller sibling, the **Ultrastar 9LP**, shares the same spin and transfer rates but has a 9.1GB capacity and five platters. The Ultrastar 18XP sells for \$1,745 (list price), and the Ultrastar 9LP sells for \$1,080 (list price).—Josh Levy



MORE SPACE, MORE SPEED: Brand-new hard disks from IBM, Western Digital, Quantum, and Seagate (seen clockwise from left).

its 9.1GB **Ultrastar 9ZX**. A six-platter Ultra-SCSI device, the Ultrastar 9ZX has a 40-MBps transfer rate. The disk is designed for departmental and enterprise servers and sells for \$1,245 (list price). It ships with IBM's Drive-TIP, a technology

SOUND CARDS

More Audio Ideas

If you want vivid crashes and booms from PC shoot-'em-up games and rich, clear bass from your favorite MIDI-compatible sound cards, then you will need a truly top-quality sound card.

The **PCI-128 WAVE**, from Aztech Labs (510-623-8988, www.aztechca.com), is a \$199 General MIDI-compatible sound board that provides 128 simultaneous polyphonic voices. Compatible with the AdLib, Sound Blaster 2.0, and Roland MT-32 standards, it also supports the Roland MPU401 UART inter-

face and comes with 14 multimedia titles, including a MIDI orchestrator. It's designed to work in Microsoft Windows 95, Windows NT 4.0, Windows 98, and DOS.

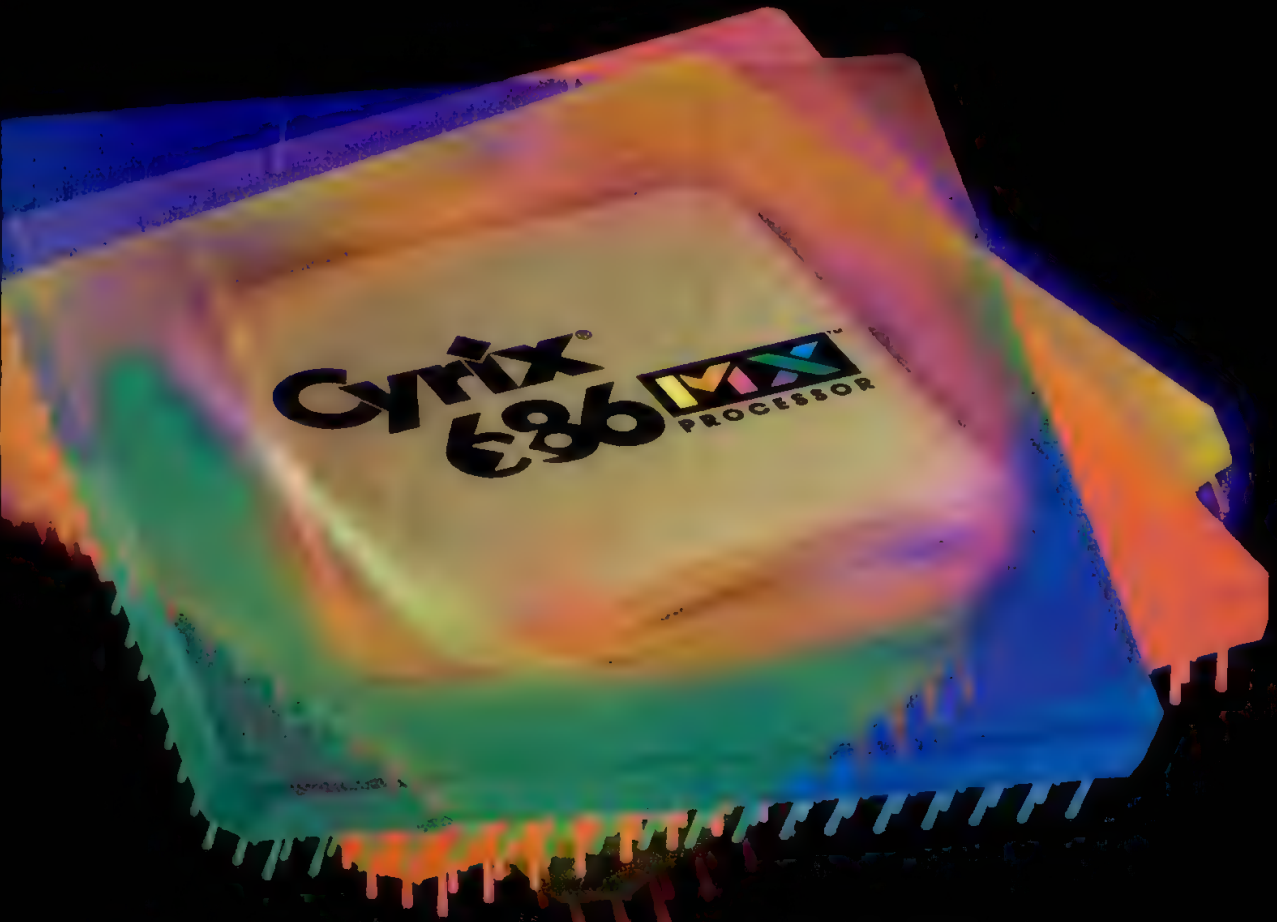
Aztech also offers the **WaveRider Platinum-3D** (\$79 list price), which can play back 96 voices simultaneously. With a dynamic range of 80 dB, it boasts a 4-watt power-amplifier output that can drive any set of passive multimedia speakers. Like its more expensive sibling, the



POLYPHONIC SOUND: Aztech's PCI-128 WAVE.

WaveRider comes with 14 multimedia titles and is compatible with major sound standards.

New from Mediatrix Peripherals (819-829-8749, www.mediatrix.com) is the **Audiatrix 3D-XG**, which sells for \$260 (street). This card provides a whopping 676 voices and 21 drum kits, while also supplying 32-note polyphony and 16-part multitimbrality. Effects include 11 types of reverb, 11 types of chorus, and 42 other sonic variations. There is also an 18-bit integrated DAC for MIDI instrument rendering, which is meant to produce professional-level sound quality. The card supports all Windows environments as well as OS/2 Warp, Linux, and several versions of Unix.—Roderick A. Beltran



www.cyrilx.com

Winstone® 97 for Windows® 95

Cyrix 6x86MX™ PR233 processor	52.3
Pentium II processor 233 MHz	51.8
Pentium processor w/ MMX tech. 233 MHz	47.0 *
Cyrix 6x86MX™ PR200 processor	49.7
Pentium processor w/ MMX tech. 200 MHz	45.3
Cyrix 6x86MX™ PR166 processor	47.6
Pentium processor w/ MMX tech. 166 MHz	43.1

Get a PC with a Cyrix 6x86MX™ processor today:

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DirectWave	800-882-8108
Enpower	800-997-2258
Racer Computer	800-308-8767
TC Computers	800-723-8282
USA Flex	800-872-3539
Zenon	800-899-6119



extreme processiNg

EXTREME
value

- runs MMX™ software • the latest feature-rich applications
- extreme speed • PR166, PR200 and PR233
- richer images • delivers brilliant colors and 3-D graphics
- 64-KByte internal cache • to boost processing performance
- software compatibility • runs Windows 95 and NT — and all your software
- proven Cyrix technology • for compatibility, quality and value

extreme
processing
for the
multimedia
rush™

Cyrix®
686 MMX
PROCESSOR

BROWSER ACCELERATORS

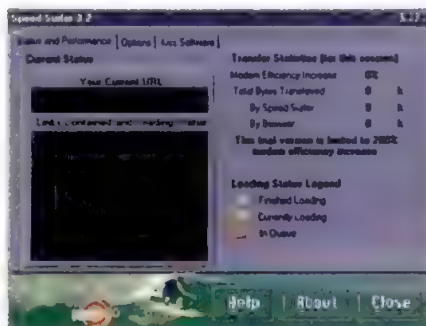
Faster! Faster! Faster!

Now that 56K and cable modems are here, Web surfing is faster than ever. But who couldn't use some extra speed?—especially if you haven't invested in one of the new fast connections. Fortunately, a new modem is not the only solution—browser accelerators are now appearing in greater numbers.

While you're reading a Web page, browser accelerators help speed surfing by taking advantage of your idle connection. Once you pause, the accelerator program anticipates which page you are going to look at next and loads it in the background—when you click on a link, the new page appears instantly.

Speed Surfer, from Kiss Software Corp. (888-768-5477, www.kissco.com), uses an Intelligent Agent to note the type of surfing you do. The more you use it, the better it should get at anticipating your moves. The sites you visit are stored in the Smartcache, which sits in front of your browser's cache and routes you more quickly through your surfing. Speed Surfer keeps a list of your top-ten most-visited sites—referred to as Fastsites—which are determined by a log of hit counts on the sites you visit. These sites are also prefetched in case your surfing sessions don't always follow a logical link-by-link pattern. Speed Surfer is available for \$29.95, and it can be used with any browser higher than Netscape Navigator 2.0 or Microsoft Internet Explorer 3.0.

WebEarly, from GOTO Software (33-3-20-66-55-00, www.goto.co.uk), also preloads each page that's linked to the one you're currently reading. You can customize this \$24.95 accelerator to load a set number of next-level pages,



SPEED RACER: While you're surfing, Speed Surfer looks ahead on the Web.

search for certain file types, or omit advertisements. Like Smart Surfer, WebEarly works with Netscape Navigator 2.0 or IE3 and up.—Jennifer L. Anderson

Enhancing Chat

Taking advantage of Java's ability to distribute applications over the Web, The Palace (503-626-7575, www.thepalace.com) is now offering a Java-based version of its client-side chat software. **InstantPalace 1.5** gives you the ability to attend live events with a graphical chat identity (the software's signature smiley-face avatar) without requiring you to download the Palace client software. InstantPalace supports Version 3.01 or higher of both Netscape Navigator and Microsoft Internet Explorer, and it requires a one-time installation fee of \$19.95 (plus \$10 per year).

At the same time, The Palace has updated its server product. **Palace Server 4.0** gives Web sites the ability to host live events or communities, and it can now integrate Web-based advertising engines with the server. Up to four ad banners can be handled at any one time. Other improvements include assigning URLs to rooms (so they may be accessed from non-Palace-connected Web sites) and requiring authentication for entry into private rooms. Pricing for Palace Server 4.0 starts at \$2,995 for 100 users.—JLA



JAVA JOLT: Java-based InstantPalace on Fore System's site.

SMALL-BUSINESS WEB SITES

Getting down to Business

People who run small businesses often don't have the time or resources to get the information that can help them run their businesses. The Web has become an indispensable location for entrepreneurs looking for advice, forms, and other details they might need to start and grow their businesses. Here are four sites that help.

The **American Express Small Business Exchange** (www.americanexpress.com/smallbusiness) offers a new way for any interested person to tap the expertise of American Express with respect to the nuances of running a small business. The site features some useful assistance for beginners, such as tools for determining how to seek financing and a sample business plan.

This free site also offers free advice. The Ask the Advisor section lets you send questions to noted small-business expert Alice Bredin, who promptly answers your questions and directs you to other online resources for

small businesses. The answers remain on the site so that all members of the small-business community can reference them; they're even organized into spe-

checklists, book information, and URLs for topics ranging from employment procedures to accounting. You can buy the books you read about, and the site offers some interactive features such as message boards and a reminder service for online events.

The **Court TV Small Business Law Center** (www.courtvtv.com/legalhelp/business) is a useful repository of sample legal forms and documents that a small business might require, such as confidentiality agreements or work-for-hire contracts. You can also use it to find a lawyer who can solve any problems you might have.

The federal government has created a useful front-end to all of the content it offers for small-business owners with the **U.S. Business Advisor** (www.business.gov). Here you will find links to FAQs about taxes, social security, and workplace safety as well as access to business forms you may need (such as W-2 forms, postal forms, and Small Business Administration loan applications).—David Lidsky



VISITOR SINCE 1998: Let American Express help you run your business.

cific categories, such as day-to-day management and taxes.

The **Smart Business Supersite** (www.smartbiz.com) is a resource site that has aggregated articles,

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5000ECX	233MHz Pentium® Processor	3.1GB HDD	32/128 MB RAM	14.1" XGA TFT	56K Modem	20X CD-ROM	\$3995.00
3030ECX	233MHz Pentium® Processor	4.0GB HDD	64/128 MB RAM	14.1" XGA TFT	56K Modem	20X CD-ROM	\$4495.00
3020ECX	233MHz Pentium® Processor	3.1GB HDD	64/128 MB RAM	14.1" XGA TFT	56K Modem	20X CD-ROM	\$4295.00
3015ECX	233MHz Pentium® Processor	2.1GB HDD	32/128 MB RAM	14.1" XGA TFT	56K Modem	20X CD-ROM	\$3595.00
3010ECX	200MHz Pentium® Processor	3.1GB HDD	64/128 MB RAM	14.1" XGA TFT	56K Modem	20X CD-ROM	\$3995.00
3000ECX	166MHz Pentium® Processor	3.1GB HDD	32/128 MB RAM	14.1" XGA TFT	56K Modem	20X CD-ROM	\$3595.00

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NETWORK FAXING

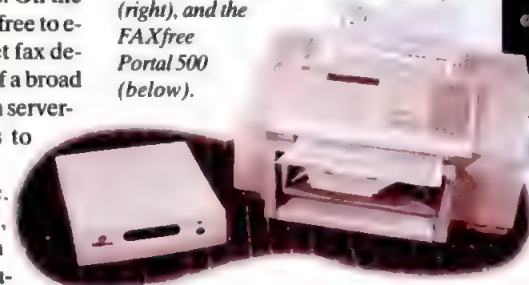
Fax for Less

Faxes make up a big part of any company's phone bill. Faxing over a network—whether it be a corporate intranet or the Internet—can cut these costs dramatically. On an intranet, you can fax for free between servers or use least-cost (global) routing to bring down long-distance fees. On the Internet, you can fax for free to e-mail boxes or to Internet fax devices. All it takes is one of a broad range of products—from server-side software packages to hardware peripherals.

On the software side, SoftTek (714-888-1181, www.sftek.com) offers an intranet fax-server solution called **w.FAX** (\$5,500 for the server software, four modem ports, and unlimited clients). All w.FAX clients are given "fax mailboxes," which can be accessed with any Web browser. Users can send, receive, and view faxes from their accounts and send faxes for free to other w.FAX servers. You can also route a fax to nonusers through your nearest w.FAX server, which dials out the fax at less cost than a long-distance phone call. Other features include e-mail notification for incoming faxes, file-attachment support, and a phonebook database.

Omtool's **Fax Sr. 2.5 for Windows NT** (603-898-8900, www.omtool.com) offers another intranet-server solution, featuring tight integration with Microsoft Outlook and Exchange 5.0. With the \$2,500 Fax Sr., users can send faxes to recipients based on their Outlook data as well as compose and receive faxes through Exchange. They can use their browsers to check "fax mailboxes," and a desktop icon alerts them to incoming faxes. Fax Sr. can also perform least-cost routing and offers connectivity to ISP-hosted Internet faxing ser-

NET FAXES: The Panasonic UF-770i (top), the w.FAX Server (right), and the FAXfree Portal 500 (below).



any PC running Microsoft Windows 95 or Windows NT 4.0. FAXfree lets you fax electronic documents over the Internet to any e-mail address by simply selecting FAXfree as your printer driver. Any file type that's sent is received as a TIFF image of the document—you



vices. Some new features in Version 2.5 include multilanguage capability, SNMP support, and a Java client that lets users select a specific send-time for transmitting faxes.

To take full advantage of Internet faxing, TAC Systems (205-721-1976, www.tacsystems.com) has rolled out its affordable FAXfree line of hardware and software. Priced at \$29.95, **FAXfree Personal 2.0** is a desktop software package that works on

don't need Microsoft Excel to receive an Excel spreadsheet, for example. Recipients without FAXfree can use any TIFF viewer to view the incoming faxes.

Meanwhile, the \$995 **FAXfree Portal 500** is a hardware box that allows standard dial-up fax machines to send faxes over the Internet. Portal 500 connects to a LAN via an Ethernet port (a dial-up PPP connection version is expected early next year) and attaches to a fax machine like an answering machine. When you send a fax, the device scans a database of up to

500 phone numbers and e-mail addresses that you configure. If it finds a match, the fax is sent to that address; if not, the fax is sent over the dial-up connection. An LCD panel shows you the method used.

Panasonic Office Products Company (800-742-8086, www.panasonic.com) offers the first Internet fax machine. The **UF-770i**

(\$4,695, or a \$1,795 upgrade from an existing Panafax UF-770) has the same features as Panasonic's high-end fax line, including a 50-page automatic document feeder, high-yield print cartridges, and Super Smoothing print technology. It

can do plain-paper printing on letter, legal, or A4 paper.

The UF-770i can also transmit faxes over the Internet as easily as over a phone line. When connected to a network or dial-up with its 10Base-T or POTS connectors, the unit can send Internet faxes if you enter an e-mail address on the keypad instead of a phone number. An Internet fax machine on the other end will then print the document automatically. Otherwise, the fax will be delivered to an e-mail box. Panasonic offers free utilities at its Web site for viewing TIFF-encoded faxes.—*Michael N. Rusignuolo*

Looking for a Middle Ground

If you need high-end features not found in POTS videophones (but the pricing on most corporate ISDN videoconferencing systems leaves you cold), Polycom Inc (800-765-9266, www.polycom.com) has a solution. The \$5,999 **ViewStation** is a low-priced system chock full of high-end features and functionality.

The ViewStation is one of the first systems to support the H.263 standard, which delivers enhanced video performance at 128 Kbps and is interoperable with H.320 systems. The unit delivers 15 frames per second (fps) at 128 Kbps; a 30-fps, 384- to 512-Kbps option costing \$2,999 will be available early this year.

The unit uses Polycom's Acoustic Clarity Technology to provide full-duplex digital audio. It also has a small footprint (about 8.5- by 11-inches) that easily fits on top of a requisite S-Video or composite monitor.

The ViewStation is the first videoconferencing system to use a built-in Web server and a two-port 10-Mbps

Ethernet hub; this allows system managers to handle remote diagnostics and setup. You can also show PowerPoint slides to those outside the conference by having them access the system via a browser.

An advanced voice-tracking camera centers on the speaker while ignoring background noise. The ViewPoint also supports auto-ISDN setup for easy installation and has a convenient, icon-based menu accessible through a feature-rich remote.—*MNR*



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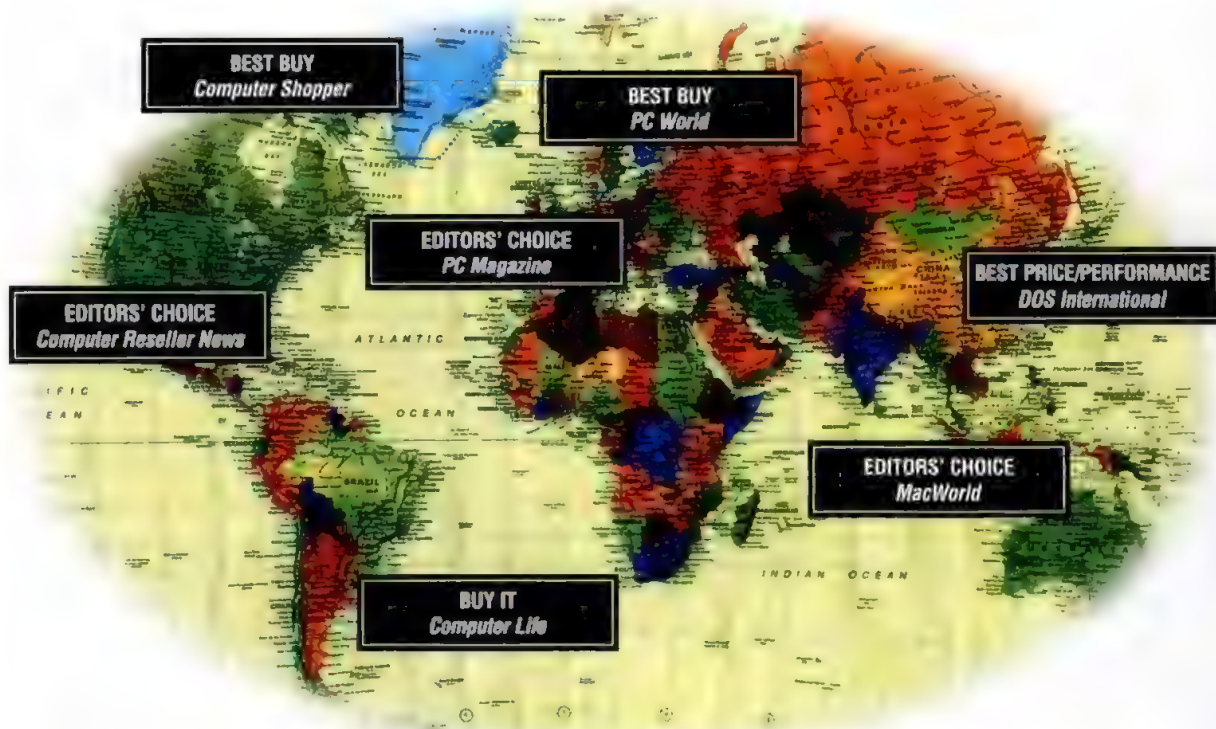
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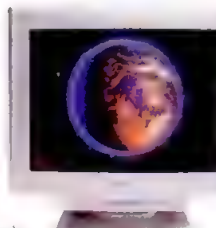
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First Looks



A Tape Restoration

PC Labs tests four new tape drives that offer an inexpensive and convenient way to back up your data.

By Alfred Poor

Pay off your credit cards every month, floss your teeth, start saving early for your retirement—and back up your valuable data on a regular basis. These are all good suggestions, but for a variety of reasons some people have difficulty sticking to them. In the case of the data backup problem, as technology continues to make things easier, more responsibility for maintaining good backup procedures is shifted to the end user.

If your computer is attached to a large network, then you should have it fairly easy. Store your important work on both the local hard disk and the server, and this alone will provide you with two copies. Also, you probably have a network

administrator who performs regular backups of the entire server's contents.

But what about the user with a standalone machine or (as is increasingly the case with small office/home office installations) a computer that is connected to others in a Windows peer-to-peer network? These people are typically on their own when it comes to making their own backups, and too often it just does not happen.

CAPACITY EVERYWHERE

One of the complicating factors in this equation is the rapid growth of hard disk capacities. New PC systems that cost less than \$1,400 frequently have 2GB or 3GB hard disks as standard equipment. It would take more than 1,400 floppy disks to

back up an entire 2GB hard disk—clearly an impractical approach. The new removable “high-capacity” disks, such as the 100MB Zip drive from Iomega or the 120MB LS-120 floppy disk drive would still require a daunting stack of 17 to 20 disks to hold a full 2GB of data. And 2GB is just the base model configuration; many systems come equipped with 4GB or 6GB drives. Even larger drives may soon become commonplace. Quantum has announced a 12GB version in its Bigfoot line of hard disks, and IBM has introduced a 16.8GB hard disk.

NEW OPTIONS

There are new optical and magnetic storage devices with larger capacities—CD-R and CD-RW, PD phase change, and the SyQuest SyJet and Iomega Jaz—but they hold only 1GB of data or less. It would take two or three disks to back up a 2GB hard disk and even more for a larger drive. Both SyJet and Iomega have announced plans for 2GB versions of their drives, and 2.7GB DVD-RAM drives are expected to reach the market soon. But even though these solutions are more practical and affordable than floppy disk drives, none of them would be able to handle a backup of a 3GB or larger hard disk while you go out to have lunch.

THE TALE OF THE TAPE

The move to hard disks with capacities of 2GB to 4GB and more has given a new lease on life to one of the oldest magnetic data storage technologies around: streaming tape. It is difficult to match tape for its per-megabyte media costs, and even without resorting to data compression you can purchase tape cartridges that allow you to back up 4GB or larger hard

INSIDE



GET REAL:

RealSystem 5.0 is the latest in Internet multimedia from RealNetworks. See page 62 for the review.

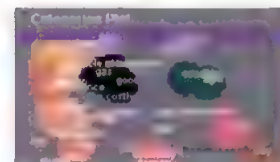
ZOOMING IN:

Olympus America's feature-loaded D-600L includes an SLR viewfinder. For the review, see page 66.



SURVEY THE NET:

With Raosoft's EZSurvey and SPSS's TextSmart, you can conduct surveys on the Internet. See page 73.



SUB-SUB-NOTEBOOK:

Mitsubishi's 2.5-pound Windows 95 AMiTY CN is in a weight class of its own. For the full story, see page 76.



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First Looks

disks in just one pass.

Given the fact that end users are putting larger and larger hard disks in their systems, tape manufacturers have started designing and marketing multigigabyte tape drives for this segment of the market—not just network administrators. For this roundup, we tested the newest models on the tape drive market, choosing to look at drives that are sold with 5GB to 8GB capacity (although capacity numbers are not always what they seem to be, as we'll get to shortly) for end-user and peer-to-peer network applications.

As a result, we tested four different tape drives: the Eagle Nest TR-4i, from Exabyte Corp.; the HP Colorado 5GB and HP SureStore T4i, from Hewlett-Packard Co.; and the Ditto Max, from Iomega Corp. The Aiwa TD8000 would have also been included in this roundup, but the company was unable to deliver an evaluation unit to us in time for our testing.

There are significant differences among these drives, including the range of tape capacities that they support, their interfaces, and their prices. But it is

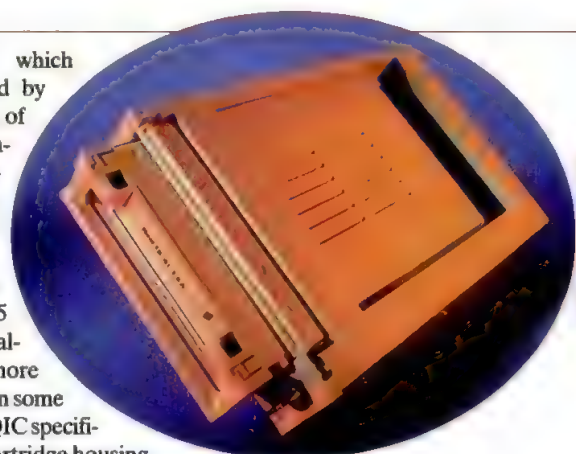
also significant that they all use similar tape cartridges based on Travan technology.

THE TRAVAN STORY

According to Quarter-Inch Cartridge (QIC) Drive Standards Inc., the standards organization for the QIC tape industry, more than 14 million QIC-compatible tape drives have been sold worldwide to date, with more than 200 million tape cartridges being sold for use in these drives. In 1995, ever-increasing hard disk capacities forced the industry to look for ways to push beyond the limits of what a QIC cartridge could hold.

The result was the Travan

specification, which was developed by a consortium of companies, including Conner, Iomega, HP, 3M, and Sony. The tape width was increased to 0.315 inches, which allowed for more data tracks than some of the earlier QIC specifications. The cartridge housing was made deeper and wider, yet it was still designed to fit inside a 3.5-inch drive bay; this increased the cartridge capacity from 307 feet in the QIC DC-2120 cartridge to 750 feet.



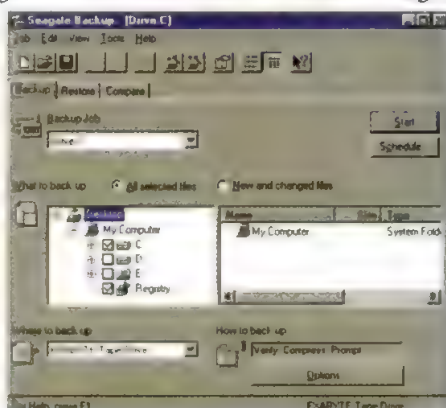
Eagle Nest TR-4i

Street price: \$400

Exabyte Corp., Boulder, CO; 800-392-2983, 303-442-4333

www.exabyte.com

Circle 412 on reader service card.



OPTIONS: The backup software that is included with the Eagle Nest TR-4i lets you backup the Registry separate from other data.

The TR-1 tape specification provided for 400MB of uncompressed capacity. But with increased recording density as well as additional recording tracks, three more tape specifications have been developed: the TR-2 (with 800MB of uncompressed capacity), the TR-3 (which contains 1.6GB of uncompressed capacity), and the TR-4 (which contains 4GB of uncompressed capacity).

IN THIS REVIEW

The two 4GB-rated drives in this roundup—the Eagle Nest TR-4i and the HP SureStore T4i—are designed to use the newest TR-4 tape cartridges. With data compression (which is typically estimated to be about 2:1), these drives are capable of storing as much as 8GB of data on a single cartridge.

The other two drives—the Iomega Ditto Max and the HP Colorado 5GB—are rated at 7GB and 5GB capacities, respectively. But unlike the TR-4 drives, this refers to the com-

PERFORMANCE TESTS

Tape Backup Drives

For the Restore tests, we timed the restoration of a 2MB TIFF file at both the highest and lowest compression settings offered by each drive's software.

For the Backup tests, we timed the backup of 292MB of compressible data files, also at both compression settings. Each vendor uses its own terminology for highest and lowest compression. For HP, it is "use data compression" and "no data compression." For Exabyte, it is "maximize compression to save space on tape" and "compress data to save time." For Iomega, it is "high" and "optimized."

Minutes:seconds
Bold type denotes first place.

	Highest Compression Setting		Lowest Compression Setting	
	Backup	Restore	Backup	Restore
Exabyte Eagle	18:24	2:20	18:25	0:37
HP Colorado 5GB	20:50	2:26	21:47	1:21
HP SuperStore	21:26	4:48	26:57	3:46
Iomega Ditto Max	26:29	4:19	31:25	2:36
	◀ BETTER	◀ BETTER	◀ BETTER	◀ BETTER

Both HP drives offer a Verify on Restore feature through software. We report results without verification here, as they are more comparable with the other units' scores. With Verify on at the highest compression setting, the Colorado's restore time was 4:52, while the SuperStore's was 9:37; at the lowest compression setting, the times were 2:29 and 7:34, respectively.

We tested on a 166-MHz Pentium Micron Millennia PC running Microsoft Windows 95 with 16MB of RAM, a 1.5GB Enhanced IDE hard disk partitioned into two logical drives (1GB and 524MB), and an Adaptec 2940 SCSI adapter.

pressed capacity of the tape. The drives use a modified TR-3 Tra-van format, which allows the Ditto Max to provide 3.5GB un-compressed capacity and the HP Colorado to provide 2.5GB. Only if your data is compress-ible and you get the estimated 2:1 compression ratio will you be able to store the maximum capacity on these cartridges. But if you compare these drives using comparable measures, the "5GB" drives actually have less capacity than the "4GB" drives.

THE DOWNSIDE

It is also important to keep in mind that these units are serial storage devices. This means that the drive must advance the tape to the point where the desired data is recorded before that data can be accessed. Compared to disk-based media, where the read/write head can move rapidly from track to track as the disk rotates, it can take much longer for a tape to find a given bit of data. Let's face it—Gutenberg had a good idea. It's easier to find information in a random-ac-cess bound book than on a Roman scroll.

As a result, tape tends to be less useful than disks for near-line storage applications where you want to be able to access archived data rapidly. But for large-capacity, all-at-once data

Editors' Choice

• HP Colorado 5GB



Removable mass-storage devices are generating a lot of excitement in the market. But if your PC has a multiple-gigabyte hard disk, these drives may be impractical. Enter

(or rather reenter) the tape drive. The four tape drives that we tested for this roundup are all aimed at single users or small, peer-to-peer networks. Though they all have redeeming qualities and are all quite capable of backing up your data, one tape drive stood out from the rest.

For ease of use, capacity, and performance at a very attractive price, the HP Colorado 5GB (\$200 street price), from Hewlett-Packard Co., earns our Editors' Choice. The drive is extremely easy to install. With a lab-coated cartoon technician to guide you, setup can be accomplished in about 5 min-

utes. The only blemish is that it actually is a 2.5GB drive. But if that's big enough for your needs, then it's the one to get.

We also single out the Exabyte Eagle Nest TR-4i as an honorable mention. At a street price of \$400 for the tape drive and the dock-ing bay, it is considerably more expensive than the HP Colorado 5GB. But it is also the fastest drive in the group, and it handles true 4GB tape cartridges. If you need to use the same drive with multiple computers that are not connected by a network, you will find it far less expensive to buy one drive and as many Eagle Nest docking bays as you need than to buy a tape drive for each system.

backup and restore activities, access speed takes a back seat to media storage capacity and price. This is where tape has strong advantages.

So if you've got your whole world stored on a new multigiga-byte hard disk and you're wonder-ing how you're going to back it all up, consider one of these tape drives. They won't help your teeth or your credit rating, but they may protect your data so you can sleep better at night.

Exabyte Corp.

Eagle Nest TR-4i

The Eagle Nest TR-4i, from Ex-abyte, is on the higher end of this price scale for this group of four, with a street ticket of \$400. This unit has a handle, which is part of the reason why you pay extra. It's the handle that tells you it's a re-movable drive, which makes it slightly more versatile than the rest of the competition for a vari-ety of applications.

The price of the drive includes the Eagle Nest docking bay (also available separately for a street price of \$100), which you'll need for the drive. This proprietary bay makes it possible to hot-swap the tape drive, which means you can install or remove it even while your computer is running. Exabyte makes other devices that can plug into the same bay, including hard disks, Zip drives, and LS-120 drives.

If you have multiple comput-

Backup Technologies: Pros and Cons

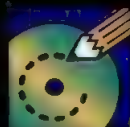
There is no single perfect backup device. Here are some of the strengths and weaknesses of different devices.



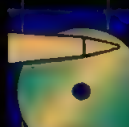
Tape drives



Removable drives



Recordable CD



Extra hard disk



DVD-RAM

Pros

Inexpensive; low media cost; large capacity.

Inexpensive; random-access storage.

Low media cost; random-access storage; disks can be read by most CD-ROM drives.

Very fast; random-access storage; relatively low cost.

Relatively fast; random-access storage; low media cost; 2.7GB un-compressed capacity.

Cons

Relatively slow; serial storage.

Relatively slow; limited to 1GB uncompressed capacity.

Limited to 680MB un-compressed capacity; cannot be erased.

Not removable, so you have only one copy; cannot be kept off-site.

Not available yet; drives may be relatively expen-sive.

First Looks

ers in an office that aren't connected by a network, you can buy docking bays for each one. Then you can use a single Eagle Nest tape drive to back them all up by simply moving the drive from machine to machine as needed.

The Eagle Nest comes with its own IDE interface card that is

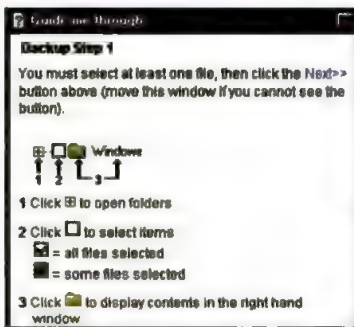
designed to coexist with the primary and secondary IDE channels already installed in your computer. An included utility helps determine how to configure the board, and the only possible difficulty you might have would be finding an available IRQ if your system is already loaded. The drive uses

Travan TR-4 tapes that have a 4GB uncompressed capacity.

The Travan TR-4i drive itself is easy to use. A locking mechanism on the docking bay engages the drive, and LED indicators show you when the drive is correctly installed and ready to run.

The included software will even warn you if you have shut down your system without turning off the drive.

The drive comes with Seagate Backup software, a full-featured package with a wide range of options. You can set up the program to perform backups at scheduled times, allowing you to



HOW TO: Software bundled with the HP Colorado 5GB tape drive walks you through the backup process.

perform automatic nightly backups. There are three compression settings: none, optimized to save time, and optimized to save space. The program works only with Microsoft Windows 95; other operating systems are not supported.

On our performance tests, the Exabyte drive was slightly faster on each measure than all the other drives reviewed in this roundup. On our backup tests, however, the choice of compression setting apparently made no difference in the backup times. The drive managed to store about 16MB per minute, which is nearly as fast as the Iomega Jaz

drive we used for comparison.

The Eagle Nest was also about twice as fast as two of the other drives on the file-restore task at the highest compression setting. When using compression optimized for speed, this unit blazed past the others, completing our restore test in only 37 seconds.

If you need a flexible design that makes it easy to move your backup tape drive (or other storage device) among multiple computers, it costs less to get one Eagle Nest TR-4i and three docking bays than it does to get three drives of the lowest-priced competitor. Its fast performance only adds to its appeal.

Hewlett-Packard Co.
HP Colorado 5GB

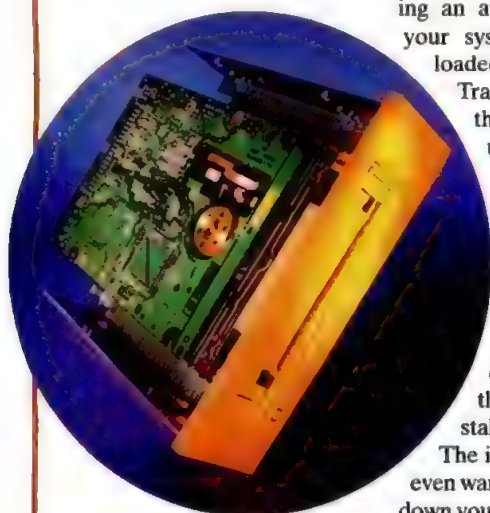


The HP Colorado 5GB—our Editors' Choice in this roundup—is tied for the lowest price of the bunch with a street price of \$200.

Like its more powerful stablemate, the HP SureStore T4i, the Colorado 5GB comes with the excellent software title Colorado Backup, from Computer Associates. But this drive also has some special features of its own.

This package is specifically intended for end users and not network specialists. Before you touch the hardware, you must run a utility in which a lab-coated cartoon technician (accompanied by a smiling computer) examines your system configuration and then gives you simple step-by-step instructions on how to set up the equipment. In our case, the program advised us that we did not need the bundled IDE interface card, and it showed us how to connect to the existing interface.

In about five minutes, you'll be ready to turn the power back on and run the program again. The on-screen technician will then determine whether your installation has been successful. Friendly and



HP Colorado 5GB

Street price: \$200 (external model: \$250)

Hewlett-Packard Co., Palo Alto, CA;
800-826-4111, 970-635-1500

www.hp.com

Circle 413 on reader service card.

SUMMARY OF FEATURES

Tape Backup Drives

	Exabyte Eagle Nest TR-4i	HP Colorado 5GB	HP SureStore T4i	Iomega Ditto Max
Street price	\$400	\$200	\$400	\$200
Maximum capacity				
Uncompressed	4GB	2.5GB	4GB	1.5GB
At 2:1 compression	8GB	5GB	8GB	7GB
Compatible cartridges (read/write)				
Travan TR-4	■ ■		■ ■	
Travan TR-3	■ ■	■	■ ■	■
Travan TR-2	■ ■	■	■ ■	■
Travan TR-1	■ ■	■	■ ■	■
QIC-3020	■ ■	■	■ ■	■
QIC-3010	■ ■	■	■ ■	■
Interface	IDE	IDE	SCSI	Proprietary
Card/cable included	■ ■	■ ■	■ ■	■ ■
Backup software	Seagate Backup	Colorado Backup	Colorado Backup	Ditto Tools
OS compatibility				
DOS 5.0/Windows 3.x/95	■ ■	■ ■ ■	■ ■ ■	■ ■ ■
Windows NT 3.5/NT 4.0	■ ■	■ ■	■ ■	■ ■ (>\$20)

First Looks

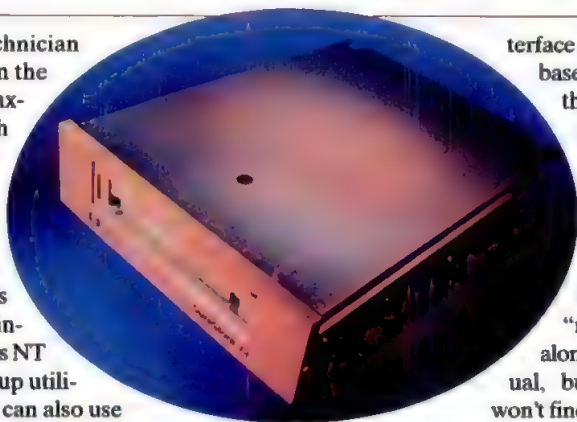
effective, the technician should guide even the most hardware-anxious users through the installation process.

We tested the system with Windows 95, but the package includes support for Windows 3.x, Windows NT 4.0's built-in backup utility, and DOS. You can also use the drive with other backup

programs if you want. The software offers a range of options for backup, including a Desktop shortcut for a full backup, and it also creates a pair of emergency boot disks that will make it easier to restore your system and recover your data in the event of a meltdown.

On our tests, the Colorado 5GB generally came in second in terms of speed, slightly ahead of the SCSI-based HP SureStore T4i. There was almost no difference between the compressed and uncompressed backup times, as both were just under 21 minutes (this works out to about 14MB per minute). The Colorado 5GB was also second-fastest at restoring a single file if the verify-after-restore feature was turned off (this makes it the equivalent of the other drives).

The only complaint we have about the Colorado 5GB is that the usually conservative Hewlett-Packard has chosen to rate the drive based on its compressed capacity instead of its uncompressed capacity of 2.5GB. This might confuse some users, who may think that the Colorado 5GB holds more than the 4GB Travan TR-4 drives. The drive is backward compatible, however, in that



HP SureStore T4i

Street price: \$560 (external model: \$500)

Hewlett-Packard Co., Palo Alto, CA; 800-826-4111, 970-835-1500

www.hp.com/go/tape

Circle 413 on reader service card.

it can read (but not write to) Travan TR-3 and TR-1 tapes and QIC-3020, QIC-3010, and QIC-80 tapes. The drive also comes in a parallel-port external version (\$250 street price).

If backing up your files easily and inexpensively sounds attractive, the HP Colorado 5GB is a great choice.

Hewlett-Packard Co.

HP SureStore T4i

The HP SureStore T4i is targeted at the higher end of the end-user market, and it carries a higher \$400 street price to match. It is intended for use in small to mid-size businesses that have peer-to-peer networks and up.

The drive relies on a SCSI interface. It does not include an in-

terface card or cable; this is based on the assumption that your system will already be equipped with both. The drive was the easiest of all to configure and install—you literally just plug it in and go.

HP includes a good "read me first" booklet along with a thorough manual, but experienced users won't find much need to study it closely and should be ready to roll in about five minutes. The hardest part of the installation process is setting the jumpers for the SCSI ID that you want to assign to the drive; they're well-labeled, however, so it takes only a few moments.

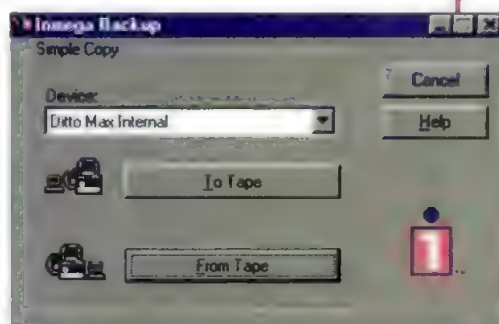
The drive comes with HP's TapeAssure utility, which tests to see whether you've installed the drive correctly. For those users who might worry about the drive being a write-only device, this program tests the interface and then writes to and reads from the tape just to make certain that everything is working correctly.

The drive comes with the same Colorado Backup software as the HP Colorado 5GB and includes the same emergency-recovery disk feature and Desktop shortcut for a full backup. In keeping with its mission to serve more sophisticated networks, the package supports a broader range of operating systems. In addition to Windows 95, Windows 3.x, and DOS 5.0 or higher, the HP SureStore T4i also supports Novell NetWare (Versions 3.12, 4.10, and 4.11), Windows NT (Versions 3.51 and 4.0), and SCO Unix. The drive can read and write both the Travan TR-4 and Colorado 5GB tape cartridges.

In terms of performance, the drive was slower than the other

TR-4 drive and even slower than the HP Colorado 5GB IDE-interface drive. It was fastest at the highest compression setting—about 13.5MB per minute. It was more than 2 minutes slower than the Colorado 5GB in locating and restoring a single file without verification on.

HP backs this drive for two years with its Express Exchange warranty, which can be comforting if you're counting on the drive to back up critical data on a regular basis. On the whole, the drive's more robust SCSI interface along with its ability to support more networks may be attractive for some users. But for most end users, the higher price and average performance of the HP SureStore T4i will be enough to send them looking at some of the other options.



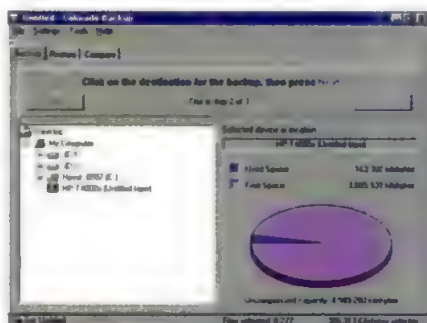
FAST SAVE: The Iomega Backup software includes a Simple Copy version that allows you to make a quick backup or restore.

Iomega Corp.

Ditto Max

Iomega has made its mark on the industry with inexpensive and high-capacity backup devices. The Ditto Max (\$200 street) joins the 100MB Zip drive and the 1GB Jaz drives in Iomega's end-user arsenal for backups.

This unit's designers clearly tried their best to make it appealing. The Ditto Max accepts tapes that come in 3GB, 5GB, or 7GB capacities (these are all based on 2:1 compression; the uncompressed values are one-half of these values). Instead of having a front slot that's similar



FREE SPACE: The backup program bundled with the HP SureStore T4i includes a convenient graph of the tape's available space.

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First Looks

to the other drives in this group, the Ditto Max features a tray that emerges from the drive (much like the tray on a CD-ROM drive). This should be a familiar design for end users, and it provides more protection for the Ditto Max's deeper 7GB cartridge.

If you need even more capacity, the Ditto Max Professional drive accepts 10GB cartridges (5GB uncompressed). And in addition to its own cartridges, the Ditto Max also can read (but not write to) some other cartridge formats, including the Travan TR-3 and QIC-3020 cartridges.

The drive connects to a 16-bit proprietary interface card (included in the above pricing)

called the Ditto-DX, which is a type of floppy disk interface. Configuration and installation is relatively easy, taking about 10 minutes for the typical user.

The Ditto Max is bundled with Iomega's own software—called Ditto Tools—which includes one-step backup and restore features plus the ability to create emergency-recovery boot disks. The drive also supports a special Flash!File feature that lets you store essential data in a 125MB portion of the tape cartridge; file restoration from this segment of the disk can be done in a matter of seconds.

Ditto Max
Street price: \$200
Iomega Corp., Roy, UT; 800-697-8833,
801-778-1000
www.iomega.com
Circle 414 on reader service card.

On our performance testing, the drive was the slowest of the group. It was fastest with maximum compression, yet it still could move only 11MB per minute. Without using the Flash!File feature, it was also the slowest of all at recovering a single file.

The Ditto Max will look good on your desktop. It accepts a wide range of cartridges with

3GB to 7 GB capacities (compressed), but it fails to deliver the most value. The difference in performance from the other drives would not be a factor if it was offset by a cost savings. Unfortunately, you can get better performance for the same price with other choices. **PC**

INTRANET WEB SERVER

Web Server with a Smile

O'Reilly's WebSite Professional 2.0 delivers a full-featured and intuitive Web server for your intranet.

By Robert P. Lipschutz

WebSite Professional, from O'Reilly, continues to impress with its excellent management user interface and its numerous Web server features. With a new set of virtual-server capabilities, WebSite Pro (\$799 list) makes an excellent choice as an intranet server. Still, some people will flinch at its lack of both browser-based remote management and a Unix port.

WebSite Pro sticks to Version 1.1's user-friendly tab interface (for a review of the previous version see "Beyond Unix," May 27, 1997) and handles mapping as cleanly as any Web server on the market. Document mappings map the URLs seen by browser users to physical directories and files on the Web server. Other mappings handle such things as the association of file extensions to MIME types.

A new IP-less virtual-server feature lets multiple host names share an IP address if they employ browsers that use

the HTTP host header field (Internet Explorer 3.0 and Navigator 3.0). For older browsers, you can set up virtual servers to use different IP addresses. Each virtual server has a separate access log, so you can analyze the servers individually.

You can allow anonymous access or require user name and password authentication on a directory basis. User names can be administered within WebSite Pro or via an existing Windows NT user domain. No browser-based remote management is available, but O'Reilly has made its Win32 remote-management software installation much easier than it used to be.

WebSite Pro bundles a helpful Web editor and tools for developing dynamic Web sites. HomeSite 2.5, from Allaire, is included for HTML authoring and editing and will serve you well if you

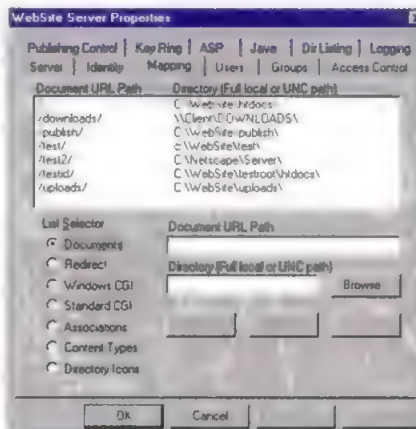
don't already use other tools. Inline Internet Systems' iHTML is also included and will give you more flexible Web pages through special tags linked into the server as a Dynamic Link Library (DLL). These can be used to set up order-entry pages, database connections, or programming logic. There is even a program included called iHTML Commerce, which will help you build an e-commerce site.

and WinCGI since the beginning, and it has always let you initiate in-process applications using the WebSite API. New to Version 2.0 are support for Microsoft Active Server Pages (ASPs) and a flexible Java development environment. But in order to use Microsoft ASPs, you must install Microsoft Internet Information Server on your server. Developers can create server-side Java applications using preexisting WSAPI

or new Java applications.

WebSite Pro's excellent documentation set will help you understand the basics and teach you how to develop dynamic content on your site. If you're not convinced WebSite Pro is the package for you, see for yourself by taking advantage of the free 30-day trial.

WebSite Professional 2.0. List price: \$799. Requires: 486-based PC or better, 16MB RAM (32MB for Windows NT), 40MB hard disk space, Microsoft Windows 95 or NT 4.0. O'Reilly & Associates, Sebastopol, CA; 800-998-9938; fax, 707-829-0104; www.oreilly.com. Circle 402 on reader service card.



WEBSITE PRO: The server properties sheet includes 12 tab screens; the flexible mapping configuration screen is shown here.

The applications development options in WebSite Professional rival any competitor's. The product has included CGI

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Web Server

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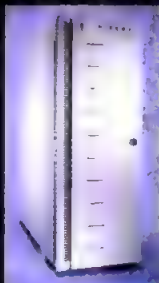
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First Looks

NETWORKING SOFTWARE

One-Stop Shopping

Microsoft's Small Business Server includes just about everything you need to get your small network up and running.

By Steve Rigney

If you are setting up a small network, you will probably want to install more than just the network operating system on your server. You might, for example, want to set up a Web server, share a fax and modem, send e-mail, and even create a network database. This means you need to buy, install, and maintain a lot of different software. Fortunately, the folks at Microsoft have made your job a little easier with the introduction of the Small Business Server (SBS).

At first glance, SBS (\$2,459 list) looks like just a collection of Microsoft products you could buy and assemble yourself, but this is only partially correct. Among other things, SBS comes with Windows NT 4.0, Proxy Server, DNS and DHCP

Servers, Exchange Server, SQL Server, Fax Server, Outlook 97, FrontPage 97, and Internet Information Server (IIS). Still, it is the simple installation and the integration among these different applications that make SBS unique.

The package is designed for small businesses, and it doesn't work well with other servers or in a workgroup environment. For example, the SBS server is installed as a Primary Domain Controller and will generate errors if you install it in an existing Windows NT domain. Likewise, the installation generates its own set of IP addresses, which may not be compatible with your existing address

scheme. Though SBS is a great solution in a closed small network, it is not designed for workgroup settings.

EASY INSTALLATION

Our favorite feature of this product is the installation utility. Installing Windows NT is not a complicated task, but installing products such as the DNS and DHCP servers can be difficult. SBS walks you through all of the installation steps and makes sure you don't forget any of them. The installation utility requires you to answer only a few questions, such as your company, your domain names, and the domain name of your PC.

After the installation is complete, the program presents you with a to-do list that prompts you to set up users, add a network printer, and even sign up with an

ISP. The Proxy Server is configured with the ISP information, and each of

ADMINISTRATION

In addition to making installation easy, SBS also provides a single console for administering all of the different applications and users. From a single utility, you can add users, set up e-mail addresses, configure your dial-in accounts, and monitor server usage. The console is customizable, so you can add your own icons for performing specific tasks.

Even though the bundled ap-

TO-DO LIST: After you've finished installing SBS, the to do list will walk you through setting up users and other network devices.

plications work the same way as their standalone counterparts, we did notice a few limitations. The most obvious limitation to the SQL server application is the database limit of 1GB. Likewise, the Exchange server limits e-mail attachments to 1MB, but developers at Microsoft plan to take care of this problem.

change server does not include the Exchange connector, so you cannot attach it to an existing Exchange mailbox or communicate between two servers. The Fax and Modem servers are available only with SBS and can't be purchased them separately.

ON THE CLIENT SIDE

Most of the design work went into building an easy-to-install network operating system, but Microsoft did not forget about the client side. SBS comes with two utilities that make it simple for you to connect your client PCs to the network.

The Setup Computer Wizard (SCW) runs on the server and allows you to generate disks

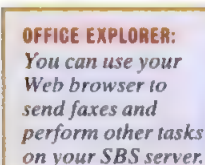
with all of the information you need to connect your client PCs. The SCW utility will prompt you for the name of the new PC and will automatically assign all of the network addresses and card settings.

When the SCW utility is finished, it generates a program called the Integrated Client Setup (ICS). You run the ICS program on the network client

PCs to connect them to the server with the settings you define. The only real work involves making sure that you have a network adapter installed and working on the client PC. SBS will prompt you to install one if it doesn't already detect one.

Once you're up and running, Microsoft helps you keep it that way. Online tutorials and documentation are provided to help users perform various network tasks, such as connecting to a shared printer. So if you're looking for an easy way to get a small group of users up and running on a network, Microsoft's SBS may just be the ticket.

Microsoft Small Business Server. List prices: \$2,459 for a 25-user license, \$1,499 for a 5-user license, and \$309 for additional 5-user client packs. Requires: Pentium/100 or Alpha processor PC or better, 64MB RAM, 2GB disk space, CD-ROM drive, network adapter card, 28.8-Kbps fax modem. Microsoft Corp., Redmond, WA; 800-426-9400, 206-882-8080; www.microsoft.com. **Circle 411** on reader service card.





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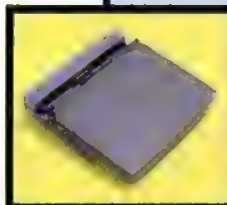
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INTERNET MULTIMEDIA

Real In the Video

Improvements in streaming media highlight RealNetwork's newest RealSystem version upgrade.

By Jan Ozer

With RealSystem 5.0, RealNetworks (formerly Progressive Networks) continues the pattern of innovation started in 1995 when the company introduced multimedia to the Internet with RealAudio. RealSystem 5.0 features creative, advanced functionality that will soon prove invaluable to high-volume video producers. Facing competitive pressure from Microsoft's free Netshow, Real is also offering free streaming audio and video to lower-volume producers who don't need the special features offered by RealSystem 5.0.

In one critical area, however, Real's new emperor wears no clothes. Although we verified the vendor's claims of faster display rates for high-resolution video, this improvement came at the cost of slightly degraded video quality (contradicting Real's claims of better quality). That said, video quality is still comparatively high at middle and high bandwidths, and any Webmaster posting video files on a Web site will find RealSystem 5.0 worthy of consideration.

COMPLETE PACKAGE

Real's product family includes encoders that create compressed files, players that decompress and play streaming media at the client site, and servers that distribute media from the Internet server. To gain the benefits of RealSystem 5.0, producers must upgrade to the new server and encoding tools. In addition, all clients must upgrade to the new players.

While Real continues offering free encoding tools, RealSystem 5.0 debuts RealPublisher (\$50 street), which encodes and creates HTML pages and all re-

quired support files. Real has also expanded and segmented its server product line to provide basic audio and video playback at minimal or no charge, with prices starting at \$5,000 for the advanced features discussed in this review.



REAL FLASH: The integration of RealAudio and Macromedia Flash animations allows for quality animations at 28.8-Kbps bandwidths and up.

FLASHY STREAMING MEDIA

Probably the most significant, broad-based new feature is the integration of RealAudio playback with Flash animations. Flash, Macromedia's vector-based streaming format, provides high-quality animations at extremely compelling bandwidths. Although you can synchronize .WAV files with Flash animations, the file that resulted when we tried this was too bulky to stream over TCP/IP connections at low bandwidths.

To synchronize the playback of Flash/RealAudio-compressed files, you must prepare your Flash animations as usual and then export separate .WAV audio and Flash animation-only files. You can then encode the .WAV audio into RealAudio format using any Real encoder.

When building a Web page, you synchronize the two files by linking them in the metafile used by Real to initiate communication between server and player. When reading the

ing insertion. This allows producers to insert ads seamlessly into the video stream (with API hooks to third-party ad servers).

RealSystem 5.0 also debuts user authentication at the player level for access to Real media streams. Valuable for both security and revenue generation, this feature provides media distributors with two levels of security: simple checking of user names and encrypted user-name and password protection. Taken as a whole, these two features significantly enhance the revenue models for making money from media on the Internet.

AUDIO ADDITIONS

RealSystem 5.0 has added three new application-specific audio-compression technologies (codecs). For extremely low-bandwidth transmissions like Splash animations, Real provides a 5-Kbps voice codec, which compares favorably with the 6.5-Kbps codec in Release 4.0. For quality-oriented voice transmissions, Real provides a 20-Kbps codec with much higher fidelity than Release 4.0's 15.2-Kbps codec.

Addressing the 56K modem market, Real has added a 32-Kbps music/audio codec with a much greater dynamic range than the 20-Kbps codec found in Release 4.0. The 32-Kbps codec is now the highest-quality music-oriented codec under the 38- to 40-Kbps effective transfer speed of most 56K modems. On our tests, all audio codecs worked as advertised.

THE TEST DRIVE

In the video arena, Real claimed both faster display rates and higher video quality than we had obtained on our tests. Although we verified an increased display rate, we found that quality actually decreased, especially on low-bandwidth files.

In order to test the display rate, we compressed three 320-by-240, 15-frames-per-second (fps) videos to around 100

metafile, the server streams and synchronizes both files automatically; unfortunately, Real's free server doesn't provide support for Flash animations—you'll have to step up to Real's Basic Server Plus (\$695 and up).

COMMERCE FEATURES

One big difference between television and the Internet is commercials—television has them and the Internet doesn't. We should say *didn't*, since RealSystem is debuting an advertis-

Kbps with both Release 4.0 and Release 5.0, and we tested decompression speed on a 133-MHz Pentium system. We originally intended to use RealPlayer's monitor to measure the display rate, but it proved unreliable, forcing us to depend on subjective observations.

We found that the Release 4.0 files appeared to drop at least half of their frames (playing at about 7 fps). Also, there was little or no frame-dropping with Release 5.0 files, indicating full 15-fps playback. Controls were also much more responsive during playback, indicating less CPU overhead with the new release.



SIDE BY SIDE: These snapshots compare the video quality of RealVideo 4.0 and RealSystems 5.0. Note the slightly degraded picture quality in Version 5.0. But keep in mind that RealSystems 5.0's display rates are twice as fast as those of Version 4.0.

At these high bandwidths, the RealSystem 5.0 files looked sharper but contained more obvious artifacts than previous versions, which revealed a softer, almost filtered appearance. Still, slightly artifacted video playing back at 15 fps is superior to

somewhat higher-quality files playing at 7 fps, so Release 5.0 is a boon for high-bandwidth video distributed via an intranet. Also new in Release 5.0 is the ability to play full-screen video by shelling out of Windows 95 and displaying files using VGA mode 32, a coarse pixel-doubled mode that expands a 320-by-240 file to full-screen size.

When testing 176-by-144, 15-fps files compressed to around 20 Kbps, however, we found Release 5.0 files noticeably more degraded than Release 4.0 files. The lower-resolution Release 4.0 files played back at full frame rate on our test ma-

chine, so Release 5.0's increase in display rate did not offset the drop in quality. This makes Release 5.0 a step backward for this class of video.

We compared Release 5.0 files to our 64- and 128-Kbps benchmark tests in our last streaming video review ("A Welcome Reception," October 7, 1997). We found slightly more artifacting but also generally smoother playback. It appears that at these intranet-oriented bandwidths, the new version would not significantly affect our quality ratings.

RealSystem 5.0. RealNetworks Inc., Seattle, WA; 800-444-8011, 206-674-2700; fax: 206-674-2699; www.real.com. Circle 401 on reader service card.

One-Stop Streaming Video

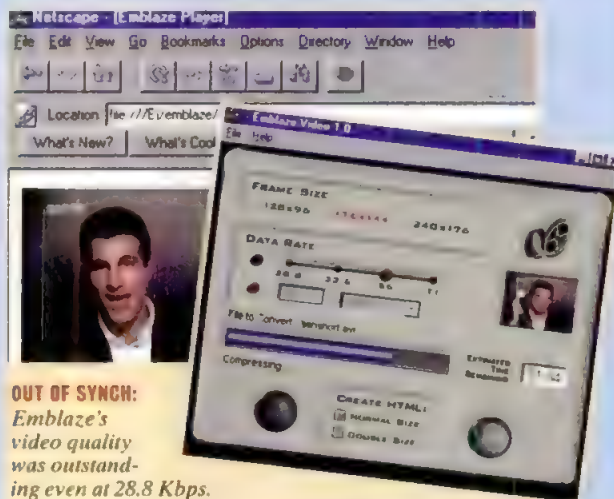
GEO Publishing's Emblaze Video system (\$295 street) delivers outstanding quality and unparalleled ease of use. Nevertheless, the codec's slow display rates and noninterleaved file type make it virtually impossible to synchronize audio and video during playback. As a result, Emblaze is appropriate for video garnishes but not the main course.

GEO's simple encoder accepts .AVI and .WAV file input in three resolutions: 128-by-96, 176-by-144, and 240-by-176. The only compression control is for data rate, with presets for 28.8-Kbps, 33.6-Kbps, 56-Kbps, and T1 connections and a data-rate slider for custom settings.

The encoder creates separate audio and video files, which are synchronized during playback (at least in theory). In general, the encoder worked as advertised and was relatively snappy, compressing a 45-second file to 64 Kbps in 4:16.

Video quality was exceptional—especially at 28.8 Kbps—easily besting other technologies, such as RealVideo and Vivo. But the complex algorithms that produced such quality also slowed decompression speed dramatically. For example, on a 133-MHz Pentium system, a 176-by-144 clip displayed between 4 and 5 frames per second (fps), increasing to about 10 fps at 128-by-96 resolution. Since audio plays in real time and Emblaze doesn't drop frames to maintain sound synchronization, audio/video synchronization was lost immediately. In contrast, Vivo and RealVideo both played back at full frame rate with complete sound synchronization on the same system at 176-by-144 resolutions and higher. These deficiencies obviously disqualify Emblaze for high-motion or talking-head videos.

On the plus side, Emblaze doesn't have a server application, which simplifies server configuration. To play Emblaze video files, you call up its Java-based playback applet in your HTML page and place the playback library (about 60 KB in size) in the same directory as the compressed files.



OUT OF SYNC:

Emblaze's video quality was outstanding even at 28.8 Kbps.

Unfortunately, this file played back at only 3 to 4 fps, losing sound synchronization immediately.

Using Java means that remote users don't have to download and install a plug-in—a real strength. But GEO's player has no controls to pause or stop video playback, an interface faux pas that forces users to exit the page in order to stop video playback.

Consider Emblaze as perhaps a better alternative to animated GIFs for video flourishes. But if you're seeking to deliver real-time, synchronized video streams, find another alternative.—JO

Emblaze Video. Street price: \$295. Requires: Java-enabled browser; Microsoft Windows 3.1, 95, or NT or Mac, Unix, or OS/2 platforms, Pentium/100 PC or better, 16 MB RAM, 5MB free disk space, 28.8-Kbps or faster Internet connection. GEO Publishing Inc., Woodland Hills, CA; 888-436-4999, 503-968-2280; www.emblaze.com. Circle 403 on reader service card.



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First Looks

DIGITAL CAMERAS

A Camera to Covet

Olympus America's D-600L brings SLR features to high-end consumer digital photography.

By Bruce Brown

Olympus America has just brought down the barriers to professional digital photography with its new Olympus D-600L. Though a \$1,300 street price might keep it off some gift lists, this camera's single-lens reflex (SLR) viewfinder, 3X motorized zoom, and noninterpolated megapixel 1,280-by-1,024 resolution brings a greater level of performance to the hobbyist or affluent consumer.

The Olympus D-600L's core technology is a progressive-scan, 1.4-megapixel CCD (charge-coupled device). The camera's feature set reads like a wish list, including an optical viewfinder with dioptic adjustment (so users with corrected vision don't need to wear glasses); a 1.8-inch color LCD panel for quick re-

view and selective deletion of stored images; automatic exposure, white balance, and focus; automatic spot and center-weighted metering for manual exposure control; and a pop-up flash with multiple modes.

The camera's seven-element f2.8 glass lens uses motorized zoom to adjust between 36- and 110-mm focal-length equivalents with standard focus of 23.6 inches to infinity (11.8 to 23.6 inches in macro mode). The camera weighs 20.4 ounces with 4 AA batteries and a media card.

Removable 3.3V Toshiba SmartMedia SSFDC cards store your images. A 4MB card is included. In standard mode (640-by-512 pixel resolution), 50

images can be saved on a 4MB card, while in high-quality and super-high-quality modes (both at 1,280-by-1,024 resolution) the image storage is 12 and 4, respectively. Cables and software

the 1,280-by-1,024 resolution modes is stunning, both in smoothness and color. The fine detail carried over to images printed on an HP PhotoSmart Printer, even when transferred to a PC and saved in JPEG format.

As image quality and user-control features increase, digital cameras will continue to have an

impact on conventional photography. If you want to jump to the head of the class with today's feature leader, the Olympus D-600L is the right choice.

Olympus D-600L. Street price: \$1,300. Requires: 386 PC or better, 24MB of RAM, 45MB of disk space, CD-ROM drive, serial port, Microsoft

Windows 95 or NT 4.0. Olympus America Inc., Melville, NY; 800-959-5935, 516-844-5000; www.olympus.com. Circle 409 on reader service card.



PICTURE PERFECT: The Olympus D-600L offers remarkable image quality.

are included so you can download images to a PC or Mac; the unit can also be connected directly to the Olympus P-300 Printer.

The image quality in either of

DVD UPGRADE KITS

More than Movies

The Creative PC-DVD Encore is an affordable step up from first-generation DVD players and upgrade kits.

By Alfred Poor

DVD upgrade kits are still a brand-new product category, but Creative Labs has already come back for an encore. The new Creative PC-DVD Encore sets new standards for both performance and cost, with a stunningly low street price of \$380.

One of this kit's key features is its second-generation DVD drive with an IDE interface. Unlike the early drives, this new model has a dual read-head mechanism, enabling it to read CD-R disks—a feature we tested with a variety of CD-R media. The drive's speed is rated at 2X for DVD-ROM use at 2.7-MBps transfer rates and up to

20X (3-MBps) for CD-ROM access.

There's more to the Encore than just faster disk speed, however. The kit includes an MPEG-2 decoder card based on Creative Labs' new DynamicXtended Resolution technology (also called Dxr2). The card has features that improve image quality while making the CPU and other system components minimal requirements. It combines the two interlaced fields of a standard TV signal and creates a single image that has twice the resolution twice as often. All of this

makes for a stable and smooth picture. The card eliminates the combing effects of rapidly moving items in the image and improves image quality through scaling and filtering. It also has digital sound output

for Dolby Digital AC-3 5.1-channel surround sound.

Even though the card relies on an analog overlay (as do most DVD upgrade kits), with a pass-through cable for your graphics adapter,

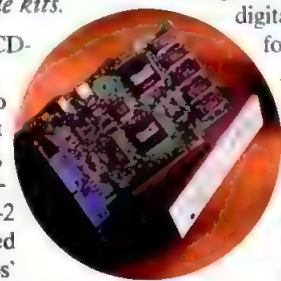
the installation and configuration process is a snap. The software automatically adjusts the analog overlay settings. The resulting images were steady and clear, whether viewed in a window or at full-screen settings (using the recommended 800-by-600 resolution). Images sent as

composite video to a TV monitor were excellent—clearly better than any broadcast, cable, or VHS image.

The PC-DVD Encore kit will also enhance your PC's performance. Though it didn't quite measure up to its specifications, we recorded a 2.07-MBps transfer rate for DVD-ROM access and 1.57 million bytes per second on the WinBench CD-ROM Sequential Reads test (2KB records). The result is speedy access to data in either format.

If you decided to wait when the first set of DVD kits appeared, your restraint has been rewarded. There's no need to wait any longer, however, as the Creative PC-DVD Encore outperforms dedicated DVD players at an irresistible price.

Creative PC-DVD Encore. Street price: \$380. Creative Labs Inc., Milpitas, CA; 800-998-5227, 408-428-6600; www.creativelabs.com. Circle 410 on reader service card.



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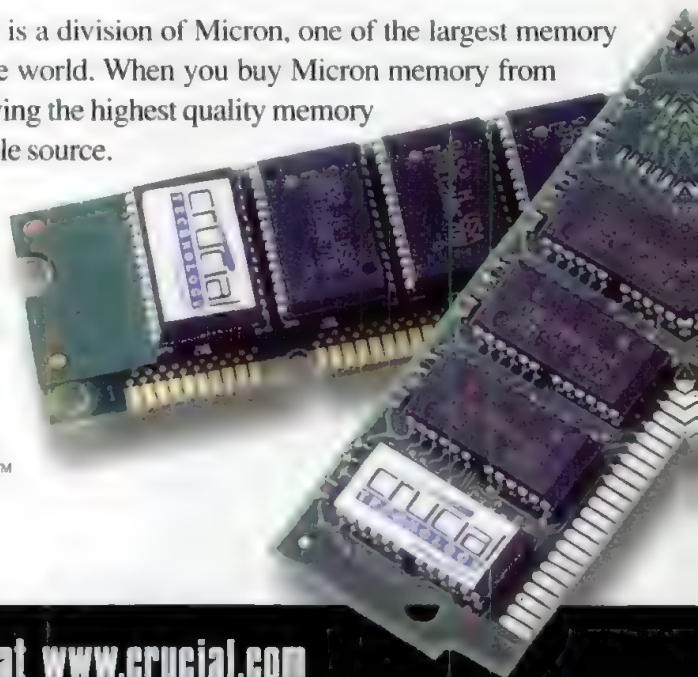
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First Looks

DEVELOPMENT TOOLS

It's a RAD Cool Tool

With its long-awaited JBuilder, Borland International adds Java to its roster of development tools.

By Richard V. Dragan

After more than a year in beta release, Borland International's entry into the Java developer tools market has finally arrived, and the news is good. JBuilder Professional 1.0 (\$799 list) is a powerful Java RAD (rapid application development) tool that combines excellent component reusability with strong database capabilities.

JBuilder's interface will be familiar to programmers who are used to Delphi (and the companion C++ product C++Builder). Instead of Delphi's Visual Component Library, JBuilder uses a set of JavaBeans components (over 100 in all) called the JavaBeans Component Library (JBCL). This rich set of components includes Abstract Window Toolkit (AWT) controls—the built-in class library in Java—as well as a wide range of beans-based components. These controls range from simple labels, text controls, and lists to grids and tree views.

GETTING TO WORK

With its variety of default project types—from applets to skeleton standalone applications—getting started in JBuilder is easy. The process of creating new JavaBeans is helped along with the BeansExpress tool, which lets you create a default bean component. It can be further customized by adding properties, methods, and generated events.

Using this wizard, you need to know relatively little about the JavaBean component model in order to write reusable components. You can also wrap an existing Java applet as a bean, which can be placed alongside other components on the palette and then reused.

The JavaBeans tutorial is a

good guide to this process. The JBuilder help system uses an elegant interface to get you to information quickly. On the whole, the system is a model of what online help should be.

The AppBrowser window lets you manage the project you've created as a group of objects or files (a feature borrowed from Delphi). You can visually add components, set properties, and add "event handlers" or code snippets that will carry out the work of your Java program. It is easy to switch from working with actual Java code to a more user-friendly interface (clicking on the Source tab shows you the code; the Design tab hides it). Like other Borland tools, JBuilder supports two-way editing, which means that manual changes in code are propagated back to the visual design (and vice-versa).

Once you've built your program, you'll need to debug it. The debugger lets you set breakpoints and watch variables. With pop-up watch windows, you can automatically view data content.

GETTING IT ON THE WEB

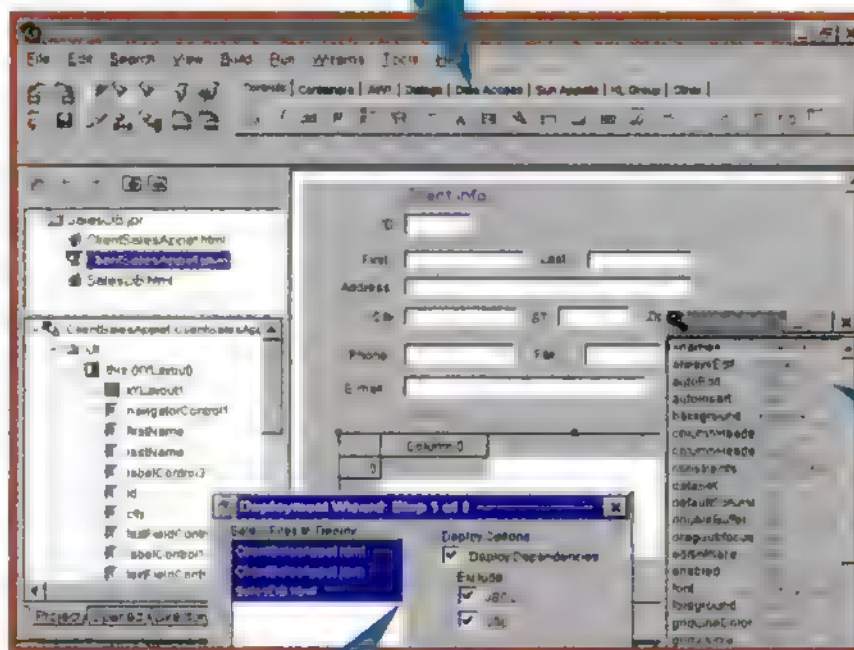
Another set of more sophisticated controls includes such bells and whistles as charts, outline controls, and table views. Many of the beans controls can be attached to databases, making JBuilder a natural for building Web-based data applications.

Separate beans exist for man-

aging database connections, tables, and record sets. Though it helps, you don't need to know how to write a lot of code to connect components to data sources over the Web. Under the hood, JBuilder bundles Object Space's JGL class library for better control of collections, a feature higher-end programmers will appreciate.

The Deployment Wizard is especially useful for getting your

JAVABEANS: JBuilder's JavaBeans Component Library palette features over 100 JavaBeans components.



DEPLOYMENT WIZARD: This feature makes easy work of distributing Java components.

Java applets or applications to your users on the Web. It also allows you to create redistributable .JAR and .ZIP files automatically from projects. (This allows you to distribute your Java components with just a few clicks of the mouse.)

Because it relies on JavaBeans, JBuilder requires a browser or Java Virtual Machine (JVM) compliant with Sun's Java Development Kit (JDK) 1.1 specification—this means Microsoft Internet Explorer 4.0 and soon Netscape Communicator. JBuilder is especially adept at targeting intranet applications (which run outside a browser). These can be deployed using Sun's JVM and Borland Just-In-Time compiler technology.

JBuilder uses classes built on JDBC to connect to a database. Actually connecting to a database, however, requires a mid-

dleware solution; for JBuilder, this is Borland DataGateway Professional (\$299 list), which is available separately. The \$49 Developer Edition, which you can try for free, lets you start writing JDBC applications right away.

DataGateway will be bundled with JBuilder Client-Server, an enterprise-level product that should be available by the time you read this. For working with databases locally in JBuilder Professional, the product ships with InterBase 4.2, a local SQL database product. Still, you will need DataGateway to do any serious database development.

Since JBuilder's interface favors Java, there are a few quirks. For instance, copying groups of controls is discernibly slow, and you can't copy and paste controls. Also, the object inspector tends to disappear

GAME PLAN: JBuilder comes with an object-oriented project manager and browser.

behind other windows.

But in spite of these quirks, JBuilder Professional 1.0 is a strong first release. Developers will find that the JBuilder environment offers powerful RAD-style programming, though not quite at the level of more mature tools, such as Delphi. With over 100 JavaBean components and database support, JBuilder offers an attractive option for developing Internet and intranet applications using Java.

JBuilder Professional 1.0. List price: \$799 (\$299 competitive upgrade, \$249 upgrade for owners of other Borland products). Requires: Pentium/90 or better, Windows 95 or NT 4.0, 32MB RAM (48MB recommended), 67MB disk space, CD-ROM drive, SVGA graphics. Borland International, Scotts Valley, CA; 800-233-2444, fax: 408-431-1000; www.borland.com. Circle 406 on reader service card.



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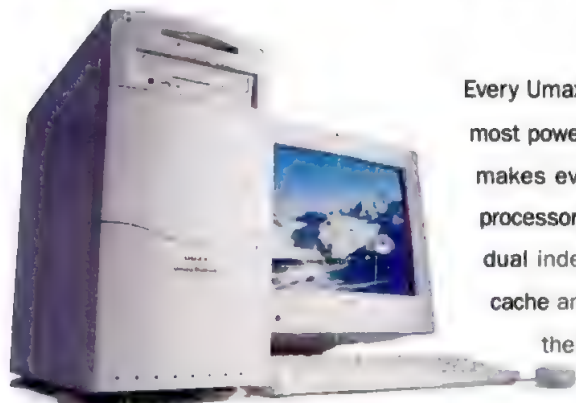


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First Looks

SURVEY SOFTWARE

Two Ways to Take Stock

EZSurvey and TextSmart help you set up, analyze, and send surveys over e-mail or post them on the Web.

By Barry Simon

Surveys are becoming an important part of many business toolboxes, particularly with the availability of the Web and e-mail for collecting data and the importance of questionnaires for gauging customer or employee satisfaction. Raosoft's EZSurvey 97 for the Internet (\$400 street) and SPSS's TextSmart 1.0 (\$2,000 street) provide impressive software solutions for two different parts of the survey picture. EZSurvey—as its name implies—allows easy setup and limited analysis of surveys over the Web or via e-mail, while TextSmart is intended to help automate the tricky process of analyzing free-flowing textual survey responses.

EZSURVEY

EZSurvey lets you design a questionnaire and then either post it on the Web or e-mail it. The questionnaire editor is simplicity itself. Questions can be of nine types: from write-in-number or list to multiple-checkbox. Portions of the edit form allow for easy entry or editing of the question text, possible responses, and the database field that will accept the responses. Up and down buttons let you rearrange the order of questions and responses.

VIA E-MAIL OR ON THE WEB

Once you've set up the form, you can choose between Web-based or e-mail-based distribution methods. For the Web-based approach, EZSurvey generates an HTML form that includes a submit button and code (a combination of Java-

Script and CGI or PERL) for storing responses in a text file on the server. You can also periodically sweep the textual data into

a database and then analyze it.

If you go the e-mail route, EZSurvey will open your mail program with an e-mail of the questionnaire, which you can customize and send. EZSurvey also provides tools for reading e-mail responses and inputting them to the database.

EZSurvey supports many popular Web authoring tools and e-mail programs. You won't get any extensive security or data-validation tools, but you will find some basics. For instance, you can limit the domains from which you can accept e-mail responses, and you can limit responses to one per e-mail address.

EZSurvey includes only the most basic analysis tools. You can get averages and standard deviations (but not medians). You can generate pie, bar, or column charts for every question in your survey, and you can create simple text or HTML reports.

These analysis tools will suffice for many simple surveys, but if you need more, the data (which is

in .DBF format) can be read by a variety of statistical programs, including Raosoft's own SurveyWin. EZSurvey is a pleasure to use and a wonderful tool for those who need to set up basic surveys via the Web or e-mail. **EZSurvey 97 for the Internet.** Street price: \$400. Requires: 2MB disk space, Microsoft Windows 95 or NT 3.51 or later, supported Web server or e-mail program. Raosoft Inc., Seattle, WA; 206-525-4025; fax: 206-525-4947; www.raosoft.com. Circle 404 on reader service card.

TEXTSMART

Free-form text responses have advantages over multiple-choice replies. You are less likely to bias survey participants with the phrasing of canned responses, and replies can contain a lot more information. But such questions are rarely used and often sit unanalyzed, since analysis is an expensive process. Professionals must look over the responses to figure out appropriate categories,

coding on top of the automated process (if desired). You tell the program which words to ignore and which words are aliases. TextSmart then employs word-cluster analysis to pick out categories using Boolean rules and places the replies into different categories.

There is no attempt at extensive context analysis, though the program does understand root stems. The underlying matrix algorithms are quite sophisticated and the results on our tests were good.

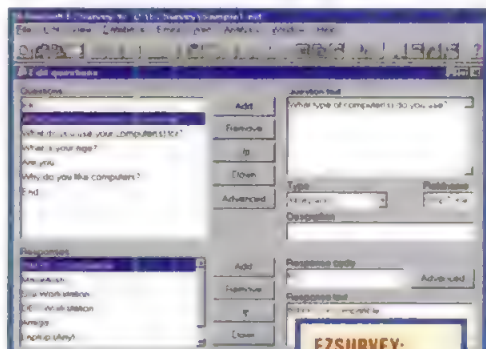
After the initial automated procedures, you can use drag-and-drop tools to rearrange categories and a brushing tool to choose a category. You can also highlight replies and associated keywords. Also featured are a categories plot and bar charts of category and word frequencies. You can save the categorized data in tab-delimited format or in a format that the SPSS statistical-analysis programs can use.

On our tests (done on a Pentium/150 with 64MB of RAM), performance was sluggish. A response to a drop after a drag took 7 seconds, and popping up a simple dialog took 3 seconds. Also, TextSmart uses a JIT Java

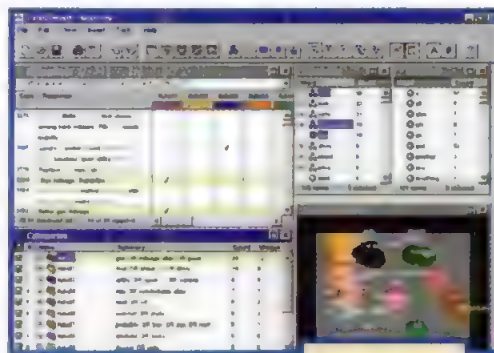
1.1 compiler, not the newest or fastest way to go.

Although the sluggishness can be annoying, the time and effort saved by using TextSmart will make this program a must-have tool for those who want extensive free-

form textual questions in their surveys. **TextSmart 1.0.** Street price: \$2,000. Requires: 16MB RAM, 12MB disk space, Microsoft Windows 95 or NT 4.0. SPSS Inc., Chicago, IL; 800-543-2185, 312-329-2400; www.spss.com. Circle 405 on reader service card.



EZSURVEY:
The questionnaire editor makes it very simple for you to set up surveys.



TEXTSMART:
Selecting a category highlights the corresponding responses.

MAKING SENSE OF THE ANSWERS

TextSmart uses intelligent text-analysis algorithms to automate the process in a simple Windows environment. It also allows hand-

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First Looks

COMMUNICATIONS HARDWARE

Who's Minding the Fax?

Panasonic's PC/Fax Store will store incoming faxes while your PC is turned off or out of town.

By Alfred Poor

Portable computing has arrived at the point where many users are choosing to do without traditional desktop PCs entirely. But when your computer goes on the road, how do you receive faxes? A desktop computer can't receive a fax when it's turned off, and a standalone fax machine won't let you preview and store faxes on your PC. Fortunately, the Panasonic PC/Fax Store—also known as the Panasonic KX-FB80—solves each of these problems.

The PC/Fax Store (\$200 street) is a standalone device that connects between your computer's fax modem and a phone jack. It uses flash memory to store up to 80 pages of incoming faxes (the Panasonic

KX-FB40 model with 40-page capacity sells for \$150). A set of LEDs indicates how much memory has been used by incoming faxes. The advantage of flash memory is that you don't lose the contents if you lose power; this means you can unplug the device and carry it to another location for downloading stored faxes.

All you need is a fax modem and fax software that lets you force a connection. Then you just press a button to initiate the transfer. The thorough manual includes instructions on how to use popular programs such as Microsoft Fax and Exchange (included with Windows 95).

The PC/Fax Store also has a jack to plug in an answering



HOLD THAT FAX: This standalone unit uses flash memory to store up to 80 pages.

machine or telephone. If you set an answering machine to answer in fewer rings than the PC/Fax Store, the unit will listen and will take over if it detects a fax handshake signal.

There are a few features that could be improved, however. For example, there is no way to create a station identifier that is displayed at the sending station. Also, a stored fax is transferred

as a single document, though a header page is included with the date, time, and size of the individual documents received.

The Panasonic PC/Fax Store is easy to install and use, and it provides a simple solution to a serious problem. If your computer and its fax modem are turned off or

they're on the road with you, this handy device will stay and monitor the fax line and be ready when you are to send them to your PC.

Panasonic PC/Fax Store. Street price: \$200. Panasonic Computer Peripheral Co., Secaucus, NJ; 800-742-8086, 201-348-7000; www.panasonic.com/alive. Circle 407 on reader service card.

NOTEBOOKS

Laptop Lite

The 2.5-pound Mitsubishi AMiTY CN walks the line between laptop and PIM.

By Nancy Hirsch

Falling somewhere between a subnotebook and a PIM is the Mitsubishi AMiTY CN (\$2,000 street), the third product from the newly formed Mobile Computing Division of Mitsubishi Electronics. This 2.5-pound mininotebook runs Microsoft Windows 95, allowing you to work with full versions of your office applications.

Squeezed into its 1.3-inch-thick package are features you'd find in an inexpensive subnotebook, including a 133-MHz Pentium processor, a 1.2GB hard disk, 16MB of EDO DRAM (upgradable to 48MB), an IRDA port, and two Type II PC card slots. If you



LIGHTWEIGHT: The AMiTY CN defines a new class of portable computers.

want to load any software (which you must, considering that the unit comes loaded only with Windows 95), you'll have to buy the optional external floppy disk drive (\$190 street) or an external PC Card or parallel port CD-ROM drive.

Keeping the AMiTY out of the subnotebook class is its 7.5-inch passive-matrix LCD.

Though the screen is a step up from any PIM, the small display is best suited for composing memos or e-mail—not typing long documents. Because the LCD is capable of only 640-by-480 resolution, we were unable to run our standard benchmark tests.

One of the inevitable drawbacks of having a 9.3-inch footprint is a cramped keyboard. Nevertheless, touch-typing on the AMiTY's well-designed 16-mm keyboard just takes a bit of practice. Another clever design concept is the way the serial and parallel port cover on the rear of the machine is hinged to swing under the unit to sit the keyboard on an incline for easier typing.

Given the fact that the AMiTY was designed for a life

on the road, the unit's 1.5-hour battery life is a major shortcoming. If you forget to turn off the unit before you close the cover, it won't automatically power down. To make matters worse, it's impossible to swap in a spare charged battery, since the original is permanently fixed. Mitsubishi offers an optional \$380 external battery, which the vendor says adds up to five additional hours of battery life.

If a subnotebook won't fit in your budget and you don't mind a PIM that won't fit in your pocket, the AMiTY may be your happy medium. Just don't let the notebook look fool you: The AMiTY is more of a supercharged PIM than a road warrior.

Mitsubishi AMiTY CN. Street price: \$2,000. Mitsubishi Electronics America, Cypress, CA; 888-445-5250; www.mitsubishi-mobile.com. Circle 408 on reader service card.

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Second Looks

AOLPRESS

The Price Is Right

By Edward Mendelson

We found AOLpress, the freeware HTML editor from America Online, an amazing bargain when we reviewed it in "Grand Designs," our March 4, 1997, roundup of HTML editors. At the time, however, the program was restricted by its 16-bit architecture and lack of long-filename support.

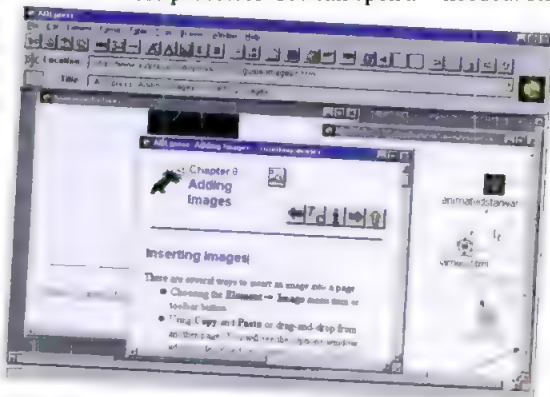
The new version, 2.0 (available for downloading at www.aolpress.com), overcomes both limitations and adds new capabilities, such as extensive support for the HTML 3.2 standard, an intuitive frames-creation feature, a dialog box for inserting Java applets, and numerous enhancements to its WYSIWYG interface. AOLpress retains its pioneering status as the only program that combines WYSIWYG Web page editing, HTML source-code editing, Web site management, and Web browsing in a single interface.

But this product isn't simply a Web site editor that looks like a browser: It is a browser. You can open and edit any page you find on the Internet, though you can save it only to your local hard disk or Web server.

When you use the program to edit pages created by other editors, it either invisibly corrects syntax errors in the original HTML code or points out the errors so you can correct them manually. This means that simply opening and saving your existing pages in AOLpress may help correct problems.

AOLpress lets you create

Web pages in a WYSIWYG mode using the same commands and techniques you'd use in a word processor. You can open a



separate HTML-editing window to edit the raw code, and the effects will appear immediately in the WYSIWYG window when you finish.

Every page you create becomes part of a mini-web that you manage from a diagram displaying all the links on your site. These mini-webs make site management nearly effortless. The diagram exposes broken links at a glance; clicking on a page icon in the mini-web window opens that page for editing.

Every page you work on gets saved when you save the mini-web. If you already have a set of linked Web pages on that disk, AOLpress will create a control file that lets you manage the pages as if they were a mini-web originally built in AOLpress.

A mini-web can also contain other mini-webs as sub-webs. You can designate a page as the template that supplies the format and content for any new pages you create. But unlike some high-end programs, you can't apply a template to pages that you have not yet created.

The frame-building feature is extremely intuitive to use. Simply create a new frameset from the File/New menu, then drag on the colored window border to create as many frames as you like. Exact frame measurements can be applied through a dialog box as needed. Though AOLpress supports every standard HTML feature, this version lets you add Java applets to your pages. But because AOLpress is not a Java licensee, you will not be able to display these applets.

For the sake of cross-platform compatibility, most of the dialogs used for finding text and image files are not Windows-standard, so you can't right-click on filenames to manage them as you can in

other Windows 95 files. There is a way to drag and drop or copy and paste images and links between AOLpress windows, but you can't drag images from Windows Explorer into an AOLpress editing page. An optional pop-up box is a useful new interface improvement that displays the underlying HTML code of any page element if you hold the cursor over it.

The program smoothly uploads pages to servers on which AOL's free AOLserver software is installed (the new version, 2.2, has just been released and is available at www.aolpress.com), and it includes an FTP feature for uploading to other servers.

You probably shouldn't hand this program to a beginner, but it may become your HTML editor of choice for managing all but the most complex Web sites. And you will never complain about the price.

DELL LATITUDE

Recall Note

By Carol Venezia

In our August roundup of notebooks, the Dell Latitude LM 166ST earned one of our Editors' Choices. Recently, in cooperation with the Consumer Product Safety Commission, Dell Computer Corp. voluntarily issued a worldwide recall of



AC adapters shipped with its Latitude LM notebooks and Latitude LM Port Replicators.

This order applies to all Latitude LM adapters sold between June 1996 and October 1997.

Dell issued the recall because it had received about 100 reports of the adapters' connector pins breaking off. Although unlikely, a broken connector pin may remain lodged in the AC adapter cord. If the power cord is still plugged into the wall outlet, there is a risk of electric shock if you touch the exposed pins.

The adapters can be identified by a bar code listed on the bottom that reads either 00097689 or 00099500; all of the former—as well as all of the latter with revision levels A00, A01, A02, or A03 at the far right of the bar code (as seen in the photo)—should be replaced.

If you have one of these adapters, stop using it immediately and contact Dell for a replacement (800-715-1483, www.dell.com/lmadapter).

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How Close Can You Get?

Sometimes you need to get really close in order to tell the story. Whether your application is quality control, instruction, school projects, Web pages, or just interesting images, macro photography gives you a new perspective and point of view.

I rely on macro photography and close-ups for a number of things, including some of the photographs on my Web site www.billsbest.com. Since the first-generation digital cameras were basically point-and-shoot with no control over focus, exposure, or anything else for that matter, I've used my camcorder and a Snappy Video Snapshot image-capture device from the outset.

TV-style zoom lenses are very capable devices, and many of them can focus all the way down to the dust on the front of the lens. My Sony camcorder is a V101, a dated but high-performance Hi8 camera. I've always assumed that the optics and CCD array on the Sony were superior to those of even the second- and third-generation camcorders, but that was just a guess until now.

Many of the newer digital cameras can get really close. When I compared their performance with that of my camcorder, I was pleasantly surprised by the results. I tested two cameras with macro capability, the Ricoh RDC-2 and the Canon PowerShot 350. The Ricoh goes all the way to a 1,024-by-768 image, while the Canon is a 640-by-480 camera.

Both have their idiosyncrasies in close-up work, but both are capable performers. I elected to use the video-out jack from both cameras for the capture, using the Snappy to eliminate differences in compression and file format. This also allowed me to preview the results on a 13-inch color monitor hooked to the Snappy's video through a jack. A TV monitor is a huge help for critical focusing and framing the image, because the viewfinder or the preview window on your computer screen is usually not sufficient.

I used two targets for my test, a laser-engraved stainless steel ruler and a pattern for counted cross-stitch needlework. The latter is especially useful for close focusing, because it's printed on white paper and can be illuminated from below with a light table. Being able to focus all the way down to the front of the lens element isn't too useful unless you can get some light between the lens and your subject. Lighting is always a challenge in macro photogra-

phy. The built-in strobes are useless because they're too close to the work and also in the wrong position. Backlighting is great if your subject is translucent. Otherwise, you have to back off a little to angle some light in there.

Depth of field is another problem. The closer you get, the less you have. If you're photographing a 3-D object, you've got to back off a little and choose a compromise focus setting. High-end camcorders have an advantage here, because you can override the f-stop manually and pour more light onto the subject to make up for it. (Smaller f-stops have greater depth of field.) With the digital cameras, you put as much light on the subject as you can and hope for the best.

In my tests, the Ricoh had a bad case of barrel distortion, where straight lines appear curved outward, but the resolution and contrast were excellent. My camcorder had slightly less barrel distortion but less contrast. The Canon had excellent flatness, with very good resolution and contrast, but couldn't get as close as the other two. All three could get close enough to have half an inch or so of the ruler fill the screen. You can see the results of my tests at www.billsbest.com/thmacro.html.

These cameras can be a pain, because they turn themselves off automatically, even on AC power. The Canon switched off soonest, followed by the Sony. The Canon forgets its white balance setting when it switches off; the Sony doesn't.

The Ricoh recalibrates itself each time. The Canon puts out several frames per second, resulting in a flickering image, but the Snappy didn't seem to mind. The Ricoh (and Sony, of course) put out video at 30 frames per second.

For sheer image quality, the Ricoh RDC-2 is the hands-down winner. If you don't need absolute flatness of field (the human eye is very forgiving), it's the one to have. Its higher resolution also gives you more to work with when you crop and edit. The Canon has terrific in-hand ergonomics, however, and is a pleasure to use off the tripod and for close-ups between a couple of feet and a couple of inches away. My camcorder? I'll save it for vacations. **PC**



DIGITAL PHOTOS

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The Japanese Invasion

While the Japanese have done a great job marketing CRT technology, memory chips, and laptop designs, they have lagged behind American marketers on the desktop. There were a number of factors involved in this lag, and most of us knew that it

was just a matter of time before they'd figure out how to do it. The time is now.

Over the years, we've seen a number of Japanese firms try the market over and over, and they never got it right. The machines were too expensive, were sold in the wrong way, or were just inadequate. It was always something. This situation was compounded by two factors in Japan: the overwhelming popularity of laptops and the dominance of NEC (which sold a proprietary system and managed a stranglehold on the Japanese desktop).

I've always kept an eye on NEC and Toshiba. Of all the Japanese companies, Toshiba did the best job of treating the American market as distinct. In no time Toshiba became a dominant force in laptops. Americans wanted big clunkers with plasma screens in the early 1980s, so Toshiba made them. Americans wanted sleek road-warrior machines in the 1990s, and Toshiba made them. It always seemed that when Toshiba decided to enter the desktop arena, it would do so with a well-thought-out plan. The result is the incredible Toshiba Infinia home and SOHO line. Get an Infinia loaded to the gills and you'll stun the family.

Meanwhile, NEC buys Packard Bell and finds a match made in heaven: quality engineering and great marketing, not to mention a sleek new design. It looks as if NEC will maintain its own brand name for the higher-end machines, such as the NEC Direction. NEC and Toshiba will open the floodgates for Japanese desktop machines.

Whenever the Japanese move into a market, that market tends to be mature and stable. This is surely the case with the current PC design. Given that a PCI-based 233- to 300-MHz Pentium with (finally) a USB connection is becoming the standard, this market is not going to change much in the years ahead, except for clock speed. In fact, once MMX was released, we all knew there wasn't going to be much more change on the desktop. MMX marked the beginning of the end for the desktop personal computer/workstation. Such things are the mainframes of our era. The Japanese will keep some excitement in the desktop segment with jazzy

ideas, but most people will simply move on to the more practical and versatile laptop-with-docking-station model of computing. Take a look at the new Micron laptop with its do-all docking station. Included in the connections of this docking station (actually an overgrown port replicator) are the USB, keyboard, mouse, SVGA, S-Video, video, SCSI, parallel, serial, Ethernet, and sound ports—you name it. This is where the market is headed.

Eventually, there will be a crossover point where a Micron laptop, with its overkill I/O in the replicator, will be more cost-effective than the large desktop. Furthermore, taking today's desktop unit and making the SCSI, Ethernet, and other add-ins work correctly still isn't easy. If all these I/O devices are built into the laptop system, the benefits are obvious.

The desktop apologists will say that nowadays you can custom-order a machine with all the capabilities of the Micron laptop, but my experience indicates that these custom "builds" seldom work perfectly, because they tend not to be as standardized as the laptop. With the laptop, everyone gets the same features. If there is a problem, then "everyone" will have it and it will get fixed properly. Try to get a "one-of-a-kind" custom problem fixed. Customization, though noble, tends to deteriorate into the Burger King "have it your way" syndrome. Go to Burger King, ask for a deer-meat burger, and see what they tell you. In fact, the options are limited and laughable. A well-thought-out

design with networking and SCSI built in is the way to go.

Now, I'm not saying desktop computers are dead, although I think they will be. Looking around my writing area here I see five of them. One is a dead Mac and another is an Atari outfitted with a Video Toaster module, which I seldom have time to play with. There are still three serious desktop machines and only one laptop nearby, although there are two other laptops floating around. The point is, I know we're close to the transition during which laptops will completely replace the dinosaur desktops we know and cherish. Either way, the Japanese will be a much more dominant force in the market than before.



DESKTOP PCs
Whenever the Japanese move into a market, that market tends to be mature and stable.

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Inside Track

From the sound of things, it's possible that Intel is going to **split the processor market** into two or three tracks. Ever since its initial announcement of the 80286, with every new processor Intel declares "This one is for servers!", then goes on to say that the processor isn't meant for the desktop single-processor user. And every time, within a few months, single-processor users are **gobbling up** the "server" processor. This situation ended recently with the Pentium line, although it kind of crept back onto the scene with the Pentium Pro and the early announcements of the Pentium II. But nobody took Intel's denial seriously, and many of us are running Pentium machines as workstations. Intel wants to continue pushing the Pentium II line on consumers and branch off, it seems, into making expensive chips for servers. All this is **an attempt to make two lines** of chips simultaneously.

Early efforts at keeping the best chips out of the hands of consumers were doomed to failure, since the new chips offered the obvious migration path. If Intel can split the migration path, it can keep single-user **performance junkies** happy and sell the more advanced chips in a market dominated by Digital and Sun. So to make the division more obvious, Intel is actually splitting into three camps: the **desktop camp**, dominated by Pentium II chips; the **multiprocessor camp**, built around the Pentium Pro, with eight or more chips in a box; and the **Merced camp**—the 64-bit super chip targeted at the Digital Alpha and the Sun SPARC—for pure server high-end use.

Intel appears smart enough to have spotted the **biggest trend** in the industry: the sub-\$1,000 high-performance computer. I can tell you for a fact that when this market emerged, Intel was **in denial**. This is no longer true, and I believe that the change in attitude is what's behind Intel's new strategy. We will see the market **blown to smithereens** over the next 12 months, with every vendor scrambling to find a comfortable price niche.

I always thought that Gateway was the vendor most vulnerable to the sub-\$1,000 machines, since it instantly subscribed to Intel's denial and targeted low-end servers as a growth market. **Secretly**, though, as I found out via a ton of mail, the company has opened numerous branded stores around the country called Gateway Country Stores. Over the years, I've been an advocate of branded stores or dealerships similar to the ones used by car makers. When I mentioned in my November 4 column that Gateway would be the perfect candidate for such a strategy, I got inundated by e-mail telling me about these local Gateway stores. When I inquired at Gateway, I was told, "Uh, I'm not sure why we're not promoting them more."

Intel wants to continue pushing the Pentium II line on consumers and branch off, it seems, into making expensive chips for servers. All this is an attempt to make two lines of chips simultaneously.

At first I suspected that this was because the decision to open such stores was so controversial for a direct-marketing company. The only direct-marketing computer company ever to attempt this was CompuAdd, which **went broke** in the process. From what I can tell, though, the Gateway stores are small and efficient—in contrast to CompuAdd's, which were ludicrous superstores. Gateway has also done a decent job of lubricating the market with TV ads to make its name well known; the CompuAdd brand name remained obscure to most people. Whatever the case, I was wrong in my assumption, and the reason these stores aren't better known is **Gateway's generally inept PR**, period. Even after I advocated that

Gateway get into retail, nobody there bothered to call and say, "Hey! We are!" It's incredible.

Gateway hopes to have **over 200 stores** by the end of 1998, mostly in midsize markets. The stores are **modeled after the Vobis chain** in Germany, and the business unit is headed up by Joe Burke, formerly of Blockbuster. Here, the kicker is that you **won't find stores** in areas with high sales tax or where a ton of machines are sold direct, such as California. Putting a Gateway Country Store in California would cause all direct factory purchases to be taxed at California's onerous 8.5 percent rate. So there will be no Gateway store in Bakersfield or Irvine, where you'd expect to see one.

Winter Cleaning Dept.: One of the biggest problems computer users have nowadays is the **slow deterioration** of Windows 95 as new programs are added to their systems. Recently I was crashing and getting all sorts of warnings as my C: drive was filling to its 2GB capacity. Though there are more gigabytes available on D:, things never seem to run right when installed on anything other than C:. Anyway, the drive was full, and I off-loaded what I could to other drives and optical disks. It got full again in a week and started acting more and more flaky. Then I remembered that I hadn't **flushed the cache** used by Internet Explorer. (Procedure: Click on View on the main menu bar, click on Options, click on Advanced for IE 3.x users or on General for IE4, click on Settings, click on Empty Folder, or Delete Files in IE4.) After doing this ridiculously buried procedure, I ended up jumping **from 9MB to 448MB** of free space! This is so pathetic. There is no reason to cache all this garbage.

While you're in the Advanced dialog box, you may as well click the "Warn Before Accepting Cookies" box so you can see how some site or other is trying to **hit your computer with a "cookie"**—one of those hidden Web files used to **track** your habits. Put a **stop** to it. ☐

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PC Hardware Under the Tree

In the previous issue, I wrote about some of the great software we saw during 1997—programs you may want to splurge on with your own dough during last-minute Christmas shopping or consider as candidates for some of that spend-it-or-lose-it dough

left in your department's PC software budget. This time, let's look at great hardware worthy of the same bucks.

Most observers' take on the PC business circa 1997 is that it's been "an evolutionary year," not one full of upheavals and skyrockets. True enough as far as that goes—the best products of 1997 have evolved from less capable predecessors—but that's far from saying they're uninteresting or not very useful. On the contrary, the products I'm recommending here are big steps forward, well worth your attention—and your gold card.

The most sensational hardware product of 1997 is Micron's desktop rocket, the \$6,200 Powerdigm XSU. With Micron's Samurai chip set driving the PCI bus at 66 MHz, plus plenty of memory (read 128MB), a second 300-MHz Pentium II CPU, and Windows NT Workstation 4.0, the Powerdigm XSU is the fastest, most satisfying PC I've ever used. As I said in "Life in the 300-MHz Lane" (December 2), the performance difference between 266- and 300-MHz PII machines is, at least at this point, not great—and bargain hunters may want to drop down to a 233-MHz Pentium II to save even more—but there are advantages to buying the high-end 2x300 Powerdigm XSU, if you can afford it. Not only do you know you have the best performance available today, but you know that you'll have a long-lived machine. That has cash value, too.

It can't match the Powerdigm XSU for raw speed, but Gateway 2000's latest revision of its Destination home-theater PC is worth a look, too. I've been a fan of the Destination since it first appeared in the spring of 1996. I've watched the neighborhood kids gather around one and seen how computing becomes a very different and much richer experience for them when it can be truly participative for three, four, five, or more at once. Even if it's just you and your child, you'll find playing at a Destination big-screen PC a much better, closer experience than sitting together squeezed up close to a normal-size screen.

This year Gateway did the predictable upgrades on the Destination, with a 300-MHz Pentium II CPU and an improved, 36-inch display (in addition to the standard 32-inch

unit). There's DVD, of course, and DVD movies look remarkably good on that big screen. (Real movie aficionados will probably still want a separate, non-PC DVD player and big-screen TV, though. DVD gets real in another 6 to 12 months; today it's mainly a gimmick.)

Compaq's big-screen entry, in combination with RCA/Thompson, has been a nonstarter: pricey, hard to find, and not very impressive when you do find it. (Buyers' tip: Gateway's high-end 300-MHz PII Destination runs \$5,000, but the company's nearly unadvertised Pentium MMX/166 configuration costs just \$2,500, including that big 31-inch display—a screaming bargain.)

We saw lots of interesting notebooks this year, including IBM's wonderful, heavy, and expensive (\$7,000) ThinkPad 770, which in its top configuration carries a 233-MHz Pentium MMX chip and a glorious 14.1-inch display. If you need a killer presentation machine and can handle the weight, it's a great choice. At the other end of the size/weight spectrum, the Toshiba T300CT notebook costs about half as much, weighs less than half as much, and may be the ultimate lightweight PC (and a better choice than Toshiba's feeble but mega-hyped Libretto).

At least for now. Unless you really have to buy a notebook PC today, I'd wait to see Hewlett-Packard's new 0.75-inch-thick ultraportable coming early in 1998, replacing the aging OmniBook 800 series. The HP machine—one of the

most talked-about hush-hush new PCs in the history of this business—is going to turn a lot of heads.

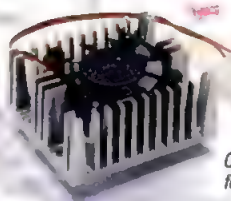
This was the year digital photography got interesting—and digital cameras got serious. Although we've had \$20,000 Kodak-modified Nikons and Canons for some time, we didn't, until recently, have cameras in the sub-\$1,000 range that could attract photographers with more than a fooling-around level of interest. In 1996 Canon broke through that wall with the PowerShot 600. This year, that \$1,000-or-so barrier simply collapsed, mainly because of two new knockouts from Olympus. The D220L and D330L came along in September. They're relatively pocketable cameras with



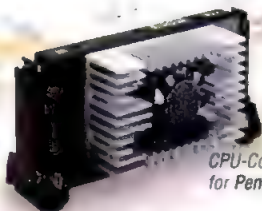
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JIM SEYMOUR

video previews, great lenses, and 1,024- by 768-pixel images. (Skip the bargain-priced D220L and spring the extra \$150 or so for the D330L, now around \$600.)

But then Olympus trumped those models just two months later with its D500L and D600L. Forget the D500L: The \$1,100 D600L gives you a fast, sharp, 3X optical zoom lens, 1,280- by 1,024-pixel images, and—finally!—at least an approximation of through-the-lens viewing. The D600L will remind you a lot of Olympus's big-selling, spacey-looking IS-series 35-mm cameras. Up close, a D600L looks as if Olympus did a quick graft of its new, top-end electronics-imaging circuitry and progressive-scan CCD onto the top IS model. But that's not an insult: Olympus had a fine design with great ergonomics in the IS series, and we're the beneficiaries of this shotgun wedding. This time next year, you'll still be happy with the D600L you buy today.

With these new cameras, a hot \$400 35-mm slide scanner and its inexpensive P300 dye-sub printer for 4- by 5.5-inch snapshot prints, Olympus, formerly dangerously late to the party in consumer digital imaging, is suddenly very hot indeed.

The three-way battle among Canon, Epson, and Hewlett-Packard for honors in high-quality color ink jet printers produced a slew of great choices this year. I call Epson's Stylus Color 600 the overall winner, a great combination of superb print quality and bargain pricing (\$275). Even if you rely on a laser printer for fast, high-quality black-only printing, you owe it to yourself to take a look at the Color 800—and to think about whether maybe you should be using its dazzling color for graphics, charts, and other images.

In the office, no printer turned so many heads this year as the Tektronix Phaser 560. This is by far the best color laser printer we've seen yet, and at \$5,000 street (you can get a cheaper configuration for a grand less, but you'll regret it), color is finally really affordable, as well as really good, for the workgroup.

The 560 delivers 1,200- by 1,200-dpi color graphics, crisp black text for \$0.03 at 17 ppm, and color pages for \$0.10 to \$0.25 each at 2 to 3.5 ppm; ignore the 560's dumb FastColor setting. Plus, the 560 prints without the thick, waxy coating on your page that Tek's other office color printers, the 340 and 350, produce.

The Tektronix Phaser 560 is not for many home offices, but it's a great tool at a good price for many businesses.

I'll bet Santa agrees. **PC**

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Ten Trends for 1998

Faster, cheaper, easier to use. You don't have to be a rocket scientist to predict these trends for virtually all hardware devices in the coming year—just as you don't have to be a genius to predict that most software will take up more disk space and consume more CPU cycles.

Here are ten serious trends that I see for the computer industry in 1998.

1. PC 98 revolutionizes PCs for power users. To meet the Microsoft spec, you need better audio and more CPU power. You also need to get rid of the ISA bus, and when that happens, your interrupt (IRQ) hassles go away. Then you'll have a PC that's truly Plug and Play. You'll be limited only by free slots, not by the handful of free interrupts.

2. Wintel antitrust cases go nowhere. Whether the Justice Department is stalking Microsoft (now) or Intel (sooner or later), the people who benefit will be lawyers, not users—and probably not competitors. Microsoft and Intel are big and maybe don't play fair, but big doesn't mean monopoly, and unfair doesn't mean illegal.

3. The \$1,000 PC is here for good. Everyone underestimated the appeal of the \$1,000 PC except Compaq. The old wisdom was that \$1,000 PCs become obsolete too soon, so you should spend more. Now a lot of people fear every PC becomes obsolete quickly, so why spend more? I still think there are serious drawbacks to sub-\$1,500 computers, but the buyers have spoken.

4. Build to order: Who's kidding whom? BTO isn't like getting a custom suit. When you're talking about retail sales, it means manufacturers building PC configurations that dealers say they can sell, not necessarily building the specific PC you want to buy. So why do BTO? It helps retail-oriented manufacturers such as Compaq cut inventory overstocks. In combination with the reduced number of models available in stores these days, retail BTO gives individual buyers fewer choices, not more.

5. The digital darkroom is a year away. The pictures you can get with sub-\$1,000 electronic cameras and \$500 ink jet printers are pretty close to traditional prints at sizes up to 8 by 10 inches. But there are still too many plugs, wires, and cables, and too few standards to entice the casual user. The same holds true for PC-based editing of home (camcorder) movies. Power users will be happy with the technology, but most users will want to check back in 1999.

6. The government handcuffs the PC industry over encryption. Americans aren't the only ones who know how to write encryption software. Even if we were, we can't keep it from being exported: If we can't stop plane-loads of cocaine from

coming in, we surely can't stop floppy disks from going out. Lastly, a lot of people believe that individuals ought to be able to keep their information private from competitors, from foreign governments, and even from their own governments. Innocent people like to keep secrets, too.

7. Apple packs it in. All that Apple has left now is slivers of the home and educational markets and the majority of the DTP/graphic arts/prepress market. When the last of the good graphics/publishing software gets ported to Windows NT 5.0, the Mac could become just another display behind glass in the Boston Computer Museum. Shame. Apple was great competition for Wintel. But make no mistake: Apple's death certificate will read "Cause: self-inflicted wounds."

8. It's not just Intel inside. Though the CPU can provide multimedia functions, it's still unclear why a \$250 CPU should be bogged down with work that could be handled effortlessly by a \$20 DSP. You're better off allocating some of your CPU budget to more RAM and a multimedia coprocessor.

9. The year of. . . These technologies will make a splash in 1998: Universal Serial Bus and USB devices (finally); sub-

\$1,000 19-inch monitors; PDAs using Windows CE 2.0; digital loudspeakers; virtual Dolby Pro Logic on high-end game machines (five-speaker sound from two speakers); DVD-ROM; and PC TV (but only if vendors can give you picture quality equal to what you get on a decent TV set).

10. Not quite the year of. . . Maybe they'll be here in 1998, but more likely they won't have much market impact until 1999: DVD-RAM; the IEEE 1394 (FireWire) bus; DriveBay, the universal-size bay for removable drives and other I/O devices; hand-held PCs in cars; 15- to 17-inch desktop LCDs; 15-inch laptop displays; PCs controlling home entertainment systems; and battery power for laptops on airplanes. **PC**



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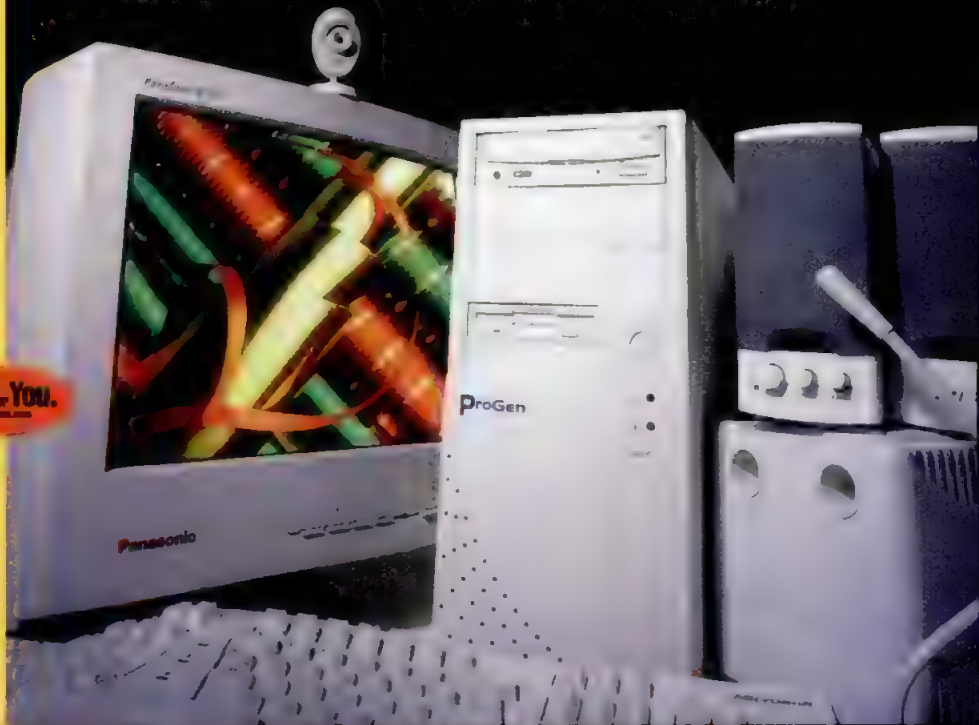
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- ▶ AGP Video Graphics Card, 8MB SGRAM
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- ▶ Subwoofer Sound System w/ Amplified Stereo Speakers
- ▶ MS IntelliMouse
- ▶ MS Windows 95
- ▶ Home Office Suite/Infopedia CD pak

\$2049

266MHz Intel Pentium® II Processor

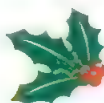
- ▶ Intel 440LX AGP Chipset
- ▶ 64MB SDRAM
- ▶ NEW! 7GB Ultra DMA Hard Drive
- ▶ 17" 28dp Digital PnP Monitor
- ▶ AGP Video Graphics Card, 8MB SGRAM
- ▶ 56K Telephony Modem
- ▶ Iomega Zip 100MB IDE Internal Drive w/One Cartridge
- ▶ Subwoofer Sound System w/ Amplified Stereo Speakers
- ▶ MS IntelliMouse
- ▶ MS Windows NT Workstation v.4.0
- ▶ Microsoft Office 97 Small Business Edition

\$2449

300MHz Intel Pentium® II Processor

- ▶ Intel 440LX AGP Chipset
- ▶ 64MB SDRAM
- ▶ NEW! 7GB Ultra DMA Hard Drive
- ▶ ProGen 17" 28dp Digital PnP Monitor
- ▶ Matrox Millennium II AGP 3D Video Graphics Card, 8MB WRAM
- ▶ 56K Telephony Modem
- ▶ Iomega Zip 100MB IDE Internal Drive w/One Cartridge
- ▶ Subwoofer Sound System w/ Amplified Stereo Speakers
- ▶ MS IntelliMouse
- ▶ MS Windows 95
- ▶ Home Office Suite/Infopedia CD pak

\$2499



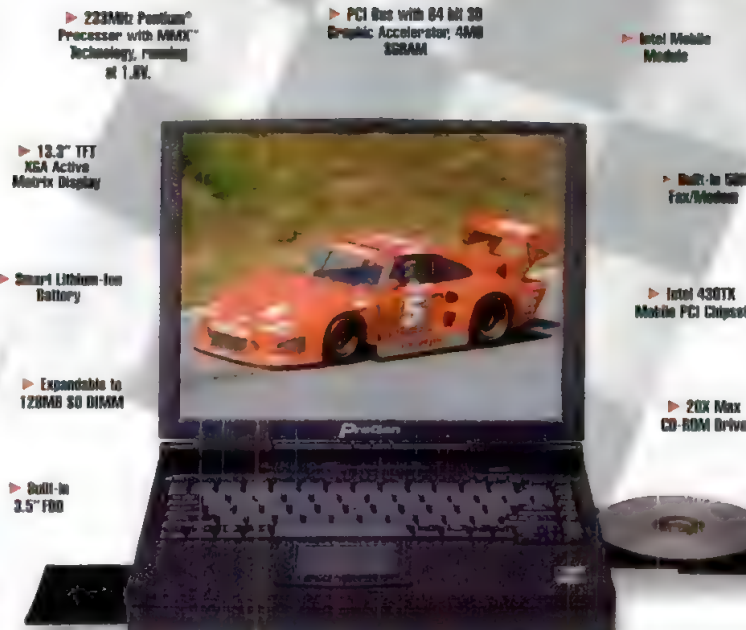
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By using the Intel Mobile Module, ProGen Notebook Series computers enjoy a definite advantage over other notebook computers built around lower-cost desktop CPUs, which can significantly increase power consumption, reduce battery life and slow performance by as much as 50%!



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- ▶ Intel 430TX Mobile PCI Chipset
- ▶ PCI Bus with 64-bit 3D Graphic Accelerator, 4MB SGRAM
- ▶ Max 20X CD-ROM Drive
- ▶ Built-in 56K Fax/Modem

- ▶ ALPS Touch Pad Pointing Device
- ▶ 16-bit SoundBlaster Pro Compatible Stereo sound (supports 3D sound and wavetable)
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- ▶ Infrared Module (including Utility) Supports FIR
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- ▶ NTSC-video Out
- ▶ Built-in 3.5" FDD, 2 Type II or 1 Type III PCMCIA Slot

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- ▶ 512K Internal L2 Cache, 3GB HDD, 48MB EDO SO DIMM, Built-in 56K bps Fax/Modem

'3349

'3449

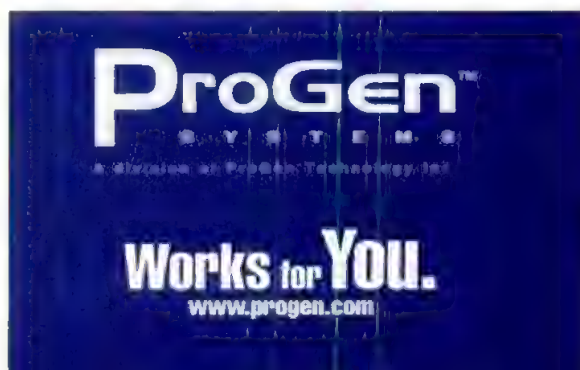
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233MHz Intel Pentium® Processor with MMX™ Technology, 1.8V

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- ▶ 512K Internal L2 Cache, 4GB HDD, 64MB EDO SO DIMM, PCMCIA 10BaseT Ethernet Card, Built-in 56K bps Fax/Modem

'3699

'4049



THE Best OF

1

9

9

The past year presented us with an embarrassment of riches in the computer industry. In this annual feature, we select the top PCs, peripherals, and software in a range of categories.

By Jake Kirchner



any magazines kick off the new year by looking back at the events of the previous one. But because of the nonstop lab testing we do every day of the year at *PC Magazine*, we have the unique ability to look back with a critical

eye at literally thousands of hardware, software, and networking products that came to market during the past 12 months.

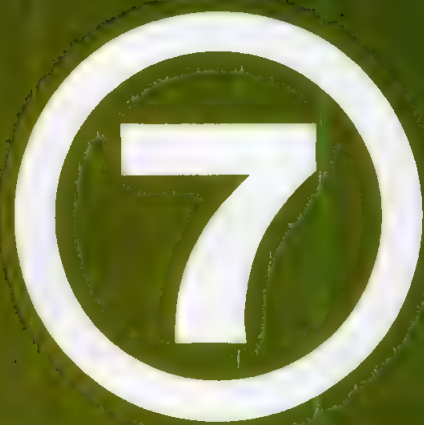
Faithful readers know that we take this nostalgic technological tour in order to identify from among those many products the handful that deserve to be honored as the best of their class. Many of the 58 products lionized here received *PC Magazine* Editors' Choice awards in our pages during the year. Others simply became personal favorites of the senior staff members and contributing editors who make the final determinations for these awards.

In the end, choosing the best products of the year is a very subjective process that involves weeks of disagreement, debate, and eventual détente. Knowing the critical nature of our everyday task of testing and evaluating hardware and software, you are right to assume that we find this entire process great fun.

And how could it not be? As in years past, 1997 did not disappoint us in its range of offerings—whether totally new, exciting products or estimable upgrades of old favorites. This year, we make awards in 55 individual product categories, a more than 50 percent increase over our “Best of 1996” lineup and an excellent indication of the continuing innovation in the personal computing industry.

As you would expect, the Internet continues to play an increasing role in these honors, with new browsers, search sites, Web servers, and authoring tools finding favor among the *PC Magazine* editors. Moreover, many of the products in the other categories staked some claim to the Internet. Just as impressive, the traditional categories of PCs, peripherals, software, networking, and utilities continued to be fertile ground for product development.

The result is something for just about everyone to like in our choice of the best products of 1997. Combined with those honored in our previous issue's Technical Excellence Awards for special innovation or technological advance, these products represent the very finest achievements of an exciting and productive year in personal computing. More important, determining the best of the year just ended gives us the perfect starting point from which to begin scrutinizing next year's contenders for similar honors.



www.pcmag.com

Visit our Web site to discuss the Best of 1997 products with the editors of *PC Magazine*. You'll also find in-depth reviews of these award-winning products plus our 1997 Awards for Technical Excellence.

PCs

From 4-pound subnotebooks to departmental servers and everything in between, we present the best PCs to come through our Labs this year.

page 101



Internet

Perhaps "Best of the Month" would be more appropriate for this fast-moving and crowded category. Nevertheless, we found some true standouts in 1997.

page 110



Networking

For this far-reaching field, we've identified the top software and hardware. Our picks include everything from network operating systems and groupware to modems and ISDN adapters.

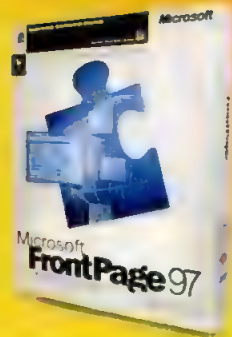
page 120



Software

In 1997, we saw a wide range of new software, including application suites, graphics and video-editing programs, and more. Here are our top picks.

page 104



Hardware

These are the absolute best devices we discovered in 1997 for printing, viewing, scanning, storing data, and more.

page 117



Utilities

Here is the best of everything 1997 had to offer to protect your PC and keep it running smoothly.

page 135

PCs

Notebooks

High-End Notebook

1 IBM ThinkPad 770

For the second year in a row, a machine from IBM's ThinkPad 700 series sits alone atop the high-end notebook jumble. The IBM ThinkPad 770, well worth its \$7,700 street price, is just four-tenths of a pound heavier than its predecessor—the 760ED. But its CPU is 100 MHz faster; its hard disk is almost 3GB larger; and its display is 2 inches bigger (measured along the diagonal). In effect, IBM has fashioned a desktop PC that happens to weigh just 8.2 pounds (system weight) and run off battery power. In addition to the fastest processor on the portable market (the 233-MHz Pentium MMX or Tillamook chip), the ThinkPad 770 has the largest hard disk (a 5.1GB IBM Ultra ATA) and the largest display (14.1-inch XGA). It was also the first notebook to incorporate a DVD drive and the latest enhancements to IBM's popular TrackPoint. And finally, with a battery life approaching 3.5 hours, the ThinkPad 770 is truly the portable with no shortcomings.—*Cade Metz*

IBM PC Co., Somers, NY; 800-426-

2968; www.pc.ibm.com.

(Reviewed: October 7, 1997, page 48.) Circle 494 on reader service card.

Value Notebook

2 Dell Latitude M166ST

Building a portable for the so-called value market is a balancing act. This year, the laptop that best balances price with features and performance is the Dell Latitude M166ST. Though it starts at just \$2,799 (direct), the 166-MHz Latitude handled our benchmark tests better than any other value machine in our midyear roundup of notebooks and includes such appealing hardware as a 12.1-inch SVGA display, a 2.1GB hard disk, and a 33.6-Kbps PC Card modem. At 7.7 pounds, the Latitude chassis integrates a lithium ion battery, good for roughly 2 hours 22 minutes, but its modular bay also supports a second battery in case you desire more operating time. This bay may also be used with a standard floppy disk or 10X CD-ROM drive. Not much more can be asked of a sub-\$3,000 notebook. Dell's latest Latitudes even feature Pentium MMX/233 processors and have been tailored to meet corporate needs.—*CM*

Dell Computer Corp., Round Rock,

TX; 800-388-8542; www.dell.com.

(Reviewed: August 1997, page 161.) Circle 495 on reader service card.

Subnotebook

3 IBM ThinkPad 560E

Granted, the subnotebook genre—consisting solely of those machines weighing less than 5 pounds—is limited to just a handful of players, but IBM's ThinkPad 500 series is the perennial standout in this category. Just over 4 pounds and slightly over an inch in thickness, the IBM ThinkPad 560E (with CD-ROM drive or modem, \$4,800 street) integrates a 166-MHz Pentium MMX processor, 256K of secondary cache, space for 80MB of memory, a 2.1GB hard disk, and (most significant) a 12.1-inch SVGA display. Naturally, this subnotebook's floppy disk drive and optional 4X CD-ROM drive must be attached externally, bringing its travel weight to 6.2 pounds with an accompanying AC adapter. But the ThinkPad 560E delivers respectable performance, and its battery affords 2 hours 10 minutes of power. IBM has even incorporated an NTSC video-out port and an optional 33.6-Kbps modem. Your favorite coffee-table book may be as small and as light, but it certainly isn't as well equipped.—*CM*

IBM Personal Computer Co.,

Somers, NY; 800-426-2968; www.pc.ibm.com. (Reviewed: August 1997, page 174.) Circle 494 on reader service card.

Hand-Held Devices

Hand-Held PC

4 Philips Velo 1

Although it was one of the last Microsoft Windows CE-based hand-held PCs coming to market,

the Philips Velo 1 (with minidock and rechargeable battery pack, \$399.99 direct) quickly pushed itself to the top of its class with a solid collection of useful features. In addition to a fast 32-bit, 36.6-MHz MIPS R3910 RISC processor and 4MB of EDO DRAM, the Velo 1 includes a low-power, 19.2-Kbps software modem with a pop-open phone jack—a far better solution than a separate PC Card modem, which can drain an HPC's batteries in minutes. The Velo 1 includes a 480-by-240-resolution monochrome display as well as a digital voice recorder. The 13-ounce Velo 1 is the top performer in its class. The only feature it lacks is a built-in PC Card slot; you'll need the \$100 PC Card module for such peripherals.

A Velo 1 with 8MB of built-in RAM (\$549.99 direct) is available exclusively via the Velo 1 Web site (www.velo1.com). A 4MB Velo 1 bundled with a 4MB upgrade DRAM module is also available (\$449.98 direct). By the time you read this, the Velo line should have a new flagship product: The Velo 500 will offer a 640-by-480-resolution monochrome display; a 75-MHz, 32-bit, MIPS R3900 CPU; a 28.8-Kbps software fax modem; and Windows CE 2.0.—*Robert S. Anthony*

Philips Mobile Computing Group,
Campbell, CA; 888-367-8356;
www.velo1.com. (Reviewed: January 21, 1997, page 52.) Circle 496 on reader service card.

Hand-Held Organizer

5 3Com PalmPilot, Professional Edition

Though Microsoft and certain hardware vendors struggle to per-



Our Contributors: JAKE KIRCHNER is the editor of *PC Magazine*. DON WILLMOTT is an executive editor, and FRANK J. DERFLER, JR., is the senior networking editor. ROBERT S. ANTHONY is a senior writer, and CADE METZ is a staff writer. JAMIE M. BSALES and DAVID LIDSKY are associate editors. JENNIFER L. ANDERSON is an editorial researcher. JIM SEYMOUR is a contributing editor of *PC Magazine*. JOHN MORRIS was the associate editor in charge of this story.

fect the Windows CE machine, the PalmPilot from U.S. Robotics (now a division of 3Com) has already found a loyal following. With the 3Com PalmPilot, Professional Edition (\$369 list), you can fit 4,000 addresses, 2,400 appointments, 750 to-do items, 750 memos, and 100 e-mail messages into your shirt pocket. The PalmPilot's plastic stylus pen and 160- by 160-pixel backlit display afford easy access to typical PIM (personal information manager) applications as well as an expense tracker and a simple e-mail client. You can synchronize data with your PC via a serial cable, an optional snap-on modem, or an optional LAN connection kit. With software vendors now developing for the PalmPilot en masse, it is more desirable than any device this side of the notebook computer.—*CM*

Palm Computing, a subsidiary of 3Com Corp., Mountain View, CA; 847-676-7323; www.usr.com. (Reviewed: April 22, 1997, page 54.) Circle 474 on reader service card.

Servers

Departmental Server

6 Dell PowerEdge 4100

If the PowerEdge 4000 series is any indication, Dell has soon come to dominate even the server market. The Dell PowerEdge 4100 that we tested (\$18,696 direct) is a wide-tower workgroup server equipped with two 200-MHz Pentium Pro processors (each holding 512K of secondary cache), space for 1GB of RAM, two SCSI adapters, six hot-swappable drive bays (four of them occupied by four Fast/Wide SCSI-2 hard disks), and two hot-swappable redundant power supplies. As priced, the PowerEdge 4100 also ships with four Fast Ethernet adapters, a hard disk controller with 8MB of ECC RAM, and a RAID controller powered by a 33-MHz RISC processor and backed by a nickel hydride battery. A Server Assistant CD, various RAID utilities,

and Intel's LANDesk Server Manager ensure smooth setup and error detection capabilities. Since our last roundup, Dell has unveiled the PowerEdge 4200, which includes dual 300-MHz Pentium II processors, 256MB of RAM, and six 4GB hard disks for \$16,700 (direct).—*CM*

Dell Computer Corp., Round Rock, TX; 800-388-8542; www.dell.com. (Reviewed: May, 27, 1997, page 47.) Circle 495 on reader service card.

Small Workgroup Server

7 Digital Prioris MX 6200

A small workgroup server, the Digital Prioris MX 6200 has the power to make the transition to a departmental server. The machine's basic configuration (\$6,330 street), which includes a 200-MHz Pentium Pro processor accompanied by a 10,000-rpm Seagate Cheetah SCSI hard disk, is ideal for 50 or fewer clients, but it can easily be upgraded to support a 200-node installation. The Pentium Pro can be replaced by two Pentium IIs without changing motherboards; space is available for 1GB of RAM; seven expansion slots can be used for additional Ethernet adapters; and four drive bays allow for additional hard disks. With its intelligent expansion options, the Prioris MX 6200 is the best option for the growing workgroup.—*CM*

Digital Equipment Corp., Maynard, MA; 800-344-4825; www.windows.digital.com. (Reviewed: October 21, 1997, page 212.) Circle 497 on reader service card.

Desktop PCs

Home PC

8 Toshiba Infinia 7260

Since its debut in 1996, Toshiba America Information Systems' innovative Infinia home PC has been a veritable technology showcase. The attractively styled Infinia was one of the first PCs to make good use of USB technology, and its wireless capabilities shine as well. The Toshiba Infinia



7260 (\$3,400 street) combines a Pentium II/266 CPU with a 6.4GB hard disk, a 17-inch monitor, a big software bundle, and a number of user-friendly features in a tightly integrated package. Its InTouch module provides one-button access to the system's many telephony, CD-ROM, and television functions. The Infinia isn't short on performance, either; it yielded strong scores on our benchmark tests.—*RSA*

Toshiba America Information Systems Inc., Irvine, CA; 800-334-3445; www.computers.toshiba.com. (Reviewed: December 16, 1997, page 177.) Circle 498 on reader service card.

Workstation

9 Micron Powerdigm XSU

Not every PC company can design its own PCI chip set, but Micron Electronics can and does so extremely well with its pace-setting workstation—the Micron Powerdigm XSU. The core reason for the unit's stellar performance on our benchmark tests is Micron's Samurai PCI chip set, which allows the Pentium II/300-based workstation to be configured with two independent PCI buses—a standard 33-MHz, 32-bit bus and a second, 66-MHz,

64-bit bus. The Samurai chip set supports dual Pentium II CPUs and up to 1GB of SDRAM. The 64-bit PCI bus helped the Powerdigm to outpace other Pentium II/300 workstations on many of our graphics tests. We tested a single-CPU model with 128MB of SDRAM and a 4.3GB, 10,000-rpm Seagate Ultra Wide SCSI hard disk, but the standard configuration now includes two Pentium II/300 CPUs. The Powerdigm is available in two configurations: \$5,204 (direct), with a Diamond Fire GL 1000 Pro graphics board with 8MB of SGRAM, and \$6,204 (direct), with a Diamond Fire GL 4000 3-D board with 15MB of 3D-RAM and 16MB of CDRAM.—*RSA*

Micron Electronic Inc., Nampa, ID; 888-634-8799; www.micronpc.com. (Reviewed: September 23, 1997, page 119.) Circle 499 on reader service card.

Corporate PCs

10 HP Vectra XA 5/200

Hewlett-Packard showcases its management expertise with the Pentium MMX/200-based HP Vectra XA 5/200 (\$3,160 street) and its home-grown software. HP's PC management software TopTools takes DMI compliance one step farther. TopTools has a friendly, functional interface, and it lets administrators get detailed information about the HP Vectras on a LAN, remotely manage them, and even perform BIOS upgrades and disable system components. The system has a lockable, tool-free chassis and comes with a Fast Ethernet adapter and McAfee's VirusScan and WebScan software. The unit was a competent performer on our tests. And its front panel offers useful extras, such as a headphone jack with a volume control and a LAN-activity LED. HP provides a three-year

warranty with a free year of on-site service.—*RSA*

Hewlett-Packard Co., Palo Alto, CA; 800-752-0900; www.hp.com. (Reviewed: June 24, 1997, page 141.) Circle 500 on reader service card.

11 IBM PC 300PL

Take a solid corporate PC and place true-blue IBM LAN technology inside it and you have the Pentium MMX/233-based IBM PC 300PL (\$2,650 street). From an asset management point of view, this product is hard to beat. Key components have unique identification marks, and the unit's NLX motherboard is extremely easy to service: It slides out after three screws and a metal side panel are removed. The review unit also had an intrusion alarm and motherboard hardware monitoring. The IBM PC 300PL worked extremely well with Intel's bundled LAN-Desk 3.0 Client Manager software,

as well as with IBM's LANClient Control Manager (LCCM), which supports remote BIOS updates and some component locking, and IBM's LAN management software NetFinity. The system has wake-on-LAN technology and remote power-on and includes an integrated 10/100 Ethernet adapter and Lotus SmartSuite 97.—*RSA*

IBM PC Co., Research Triangle Park, NC; 800-426-2968; www.pc.ibm.com. (Reviewed: December 2, 1997, page 204.) Circle 494 on reader service card.

Professional/Enthusiast PCs

12 Dell Dimension XPS D266

Boasting impressive performance, lots of features, and a hard-to-resist price tag, the Dell Dimension XPS D266 (\$2,649 direct) is a terrific high-performance PC. The Dell Dimension uses Intel's 440LX chip set and SDRAM for main memory, as well as a 7.8GB IBM Ultra ATA hard disk, a 17-inch monitor, and a STB Velocity AGP graphics card based on the nVidia RIVA 128 chip set. With these components, the unit posted stellar 3-D and disk test results. The system we reviewed was also bundled with a Sound Blaster AWE64 sound board, a 56-Kbps x2 fax modem, a set of Altec Lansing ACS290 speakers, and Microsoft Office 97 Small Business Edition.—*RSA*

Dell Computer Corp., Round Rock, TX; 800-388-8542; www.dell.com. (Reviewed: December 2, 1997, page 136.) Circle 495 on reader service card.

13 NEC Direction SPL266

The NEC Direction SPL266 (\$3,037 direct), from NEC Computer Systems Division, has everything demanding PC users are looking for. The Pentium II/266-based unit is packed with features and was a phenomenal performer, earning top scores on most of our tests. The reviewed system had SDRAM for main system memory and came with a 6.2GB IBM Ultra ATA hard disk and a Number Nine Revolution

3D AGP graphics card with 8MB of WRAM. The unit also used Intel's 440LX PCI chip set and was bundled with a 56-Kbps voice modem, a 100MB Iomega Zip drive, a 24X CD-ROM drive, Microsoft Office 97, and Altec Lansing ACS45 speakers. NEC offers 24-hour technical support, and the Direction SPL266's single-thumbscrew case is a breeze to service.—*RSA*

NEC Computer Systems Division, Mountain View, CA; 888-863-2669; www.nec-computers.com. (Reviewed: December 2, 1997, page 158.) Circle 501 on reader service card.

Software

Application Suite

14 Microsoft Office 97

Microsoft Office began 1997 as the office suite to beat. With the release of Microsoft Office 97, it further boosted its dominant position in the suites market. Like previous versions, Office 97 is available in a standard edition (\$499 list) with Word, Excel, and PowerPoint and a professional version (\$599 list) that adds the database program Access. But Office 97 also added Outlook (a new information manager and e-mail client), an animated Office Assistant, and new Internet tools. Microsoft also enhanced the integration of the suite's programs, and it introduced a shared programming language, Visual Basic for Applications, across all applications.—*John Morris*

Microsoft Corp., Redmond, WA; 800-426-9400; www.microsoft.com. (Reviewed: February 18, 1997, page 147.) Circle 465 on reader service card.

Graphics

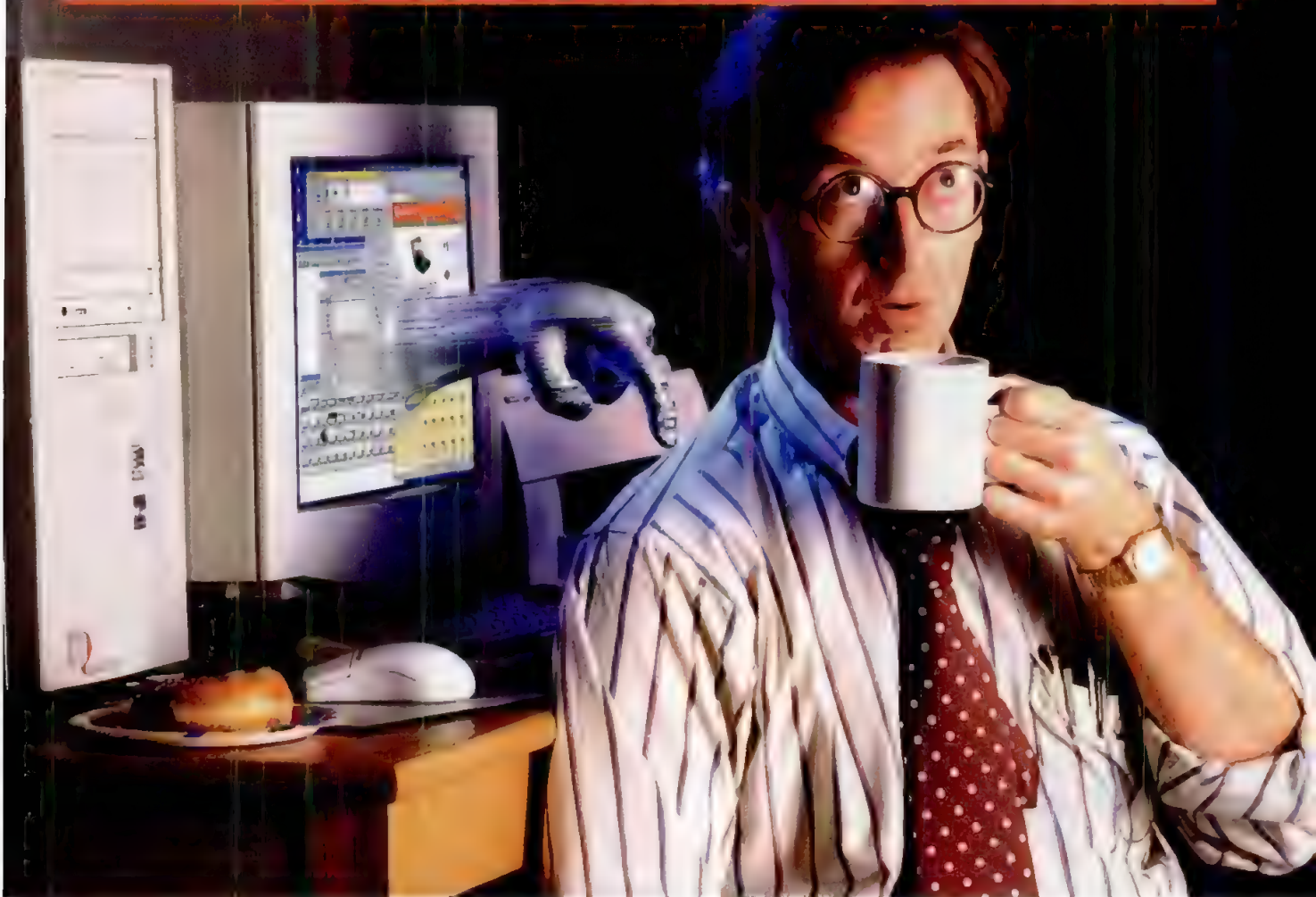
Professional Desktop Publishing

15 Adobe PageMaker 6.5

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- QP6/266 SB-4 (featuring Pentium® II Processor).....\$2499

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- Publisher 97
- Excel 97
- Small Business Financial Manager 97
- Outlook 97
- Automap Streets Plus

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QP5/233 SB-2

(with MMX™ Technology)

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- STB Nitro 3D with 4MB SGRAM
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- MS Windows 95 with MS Plus!
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QP5/166 SB-2 (with MMX Technology).....\$1599

QP5/200 SB-2 (with MMX Technology).....\$1699

QP6/266 SB-3

(featuring Pentium II processor)

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to Business

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15. continued

features print designers require combined with new, innovative Web publishing tools. PageMaker (\$550 street) supports layers (similar to an image-editing program)



and has more robust frames that can contain text and graphics. A feature called Automated Adjustments can resize and reposition page elements to convert print publications rapidly to the horizontal screen layout necessary for Web publishing. And PageMaker offers several new tools for handling hyperlinks in documents.—*JM*
Adobe Systems Inc., San Jose, CA; 800-843-7263; www.adobe.com. (Reviewed: April 22, 1997, page 149.) Circle 468 on reader service card.

Personal Desktop Publishing

16 Microsoft Publisher 97

The publishing package for the rest of us, Microsoft Publisher 97 (\$79.95 list) is a program capable of designing projects for both print and the Web. Everything in Publisher is designed for the DTP novice: Pop-up tips offer help to guide you through the program. A site-building wizard lets you choose among designs for business, community, or personal use, and another wizard automatically uploads your site to a Web server. The Publisher CD-ROM includes 5,000 clip-art images, and Microsoft supplies more than 1,000 additional graphics on its site.—*JM*

Microsoft Corp., Redmond, WA; 800-426-9400; www.microsoft.com. (Reviewed: February 18, 1997, page 60.) Circle 465 on reader service card.

Professional Image Editing

17 Corel Photo-Paint 7 Plus

Corel Corp. shook up the staid image-editing market in 1997 with the release of Corel Photo-Paint 7 Plus (\$350 street). This new version's toolset rivals that of industry stalwart Adobe Photoshop, yet Photo-Paint's well-designed interface encourages experimentation. The most significant improvements are in Photo-Paint's editing tools: new object-editing modes, transparency tools, and a dozen lens objects that let you preview

color and tonal adjustments without affecting the image. On the leading edge of Internet features, Photo-Paint can export client- or server-side image maps, and the program now supports a wider variety of file formats as well as third-party plug-ins.—*JM*
Corel Corp., Ottawa, Ontario; 800-772-6735; www.corel.com. (Reviewed: April 22, 1997, page 163.) Circle 473 on reader service card.

Personal Image Editing

18 Microsoft Picture It! 2.0

Now in its second version, Microsoft Picture It! 2.0 (\$55 street) has rapidly evolved into a powerful and easy-to-use image editor for the consumer market. Picture It!'s on-screen tips and step-by-step guides let novices begin working with images immediately. New features include edge detection (for making cutouts), a basic layers palette, better text handling, paintbrushes, and a wider selection of projects. With Picture It!, you can apply a variety of special effects to images, including neon glow, mosaic, stained glass, and watercolor. Internet features have also been enhanced with support for Kodak Magic Print Service, Kodak Picture Network, and PhotoNet.—*JM*

Microsoft Corp., Redmond, WA; 800-426-9400; www.microsoft.com. (Reviewed: December 16, 1997, page 204.) Circle 465 on reader service card.

Illustration

19 Macromedia FreeHand 7

An illustration package that appeals to both print artists and Webmasters, Macromedia FreeHand 7 (\$400 street) boasts excellent color management and faithful output, as well as Shockwave support and other Web publishing features. FreeHand 7 offers drag-and-drop integration with Adobe Photoshop, the ability to search and replace graphics in a project, and a color autotrace tool that converts bitmaps into editable

vector line art. Color Sync color matching and new tools for print output preparation ensure that what you see is what you get, making FreeHand a pleasure to work with. This product supports a wide range of Web formats—Flash, GIF89a, .PDF, PNG, and Shockwave—and an Afterburner Xtra compresses Web graphics by 30 to 75 percent.—*JM*
Macromedia Inc., San Francisco; 800-288-4797; www.macromedia.com. (Reviewed: April 22, 1997, page 187.) Circle 475 on reader service card.

Video Editing

Personal Video Editing

20 MGI VideoWave

A newcomer to video editing, MGI VideoWave, from MGI Software Corp., instantly made its mark by putting a friendly face on what has up to now been a relatively complex task. A storyboard-style editor, VideoWave (\$100 street) relies on icons, sliders, and drag-and-drop functions that make video editing comprehensible to novices. A single editing control panel lets you capture files (at up to 5 MBps on our tests), preview videos, trim clips, apply transitions and filters, generate tiling and motion sequences, or adjust the audio. Although it can't rival the sheer number of features found in other video-editing packages, VideoWave is the obvious choice for those just getting started with video editing.—*JM*

MGI Software Corp., Richmond Hill, Ontario; 888-644-7638; www.mgisoft.com. (Reviewed: October 7, 1997, page 166.) Circle 488 on reader service card.

Professional Video Editing

21 Adobe Premiere 4.2

The pioneer of desktop video editing, Adobe Premiere 4.2 (\$795 list) remains the power user's video editor of choice. This product is a traditional editor in which separate windows provide access to a multitrack SMPTE timeline, pre-



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21 continued

views, transitions, trimming functions, and a clip library. Tools such as ripple and rolling edits, multiple-track selection, and the jog, shuttle, and play commands in the clip window make it possible to edit large amounts of footage quickly. Premiere's extensible architecture helps keep it on the cutting edge; a plug-in for MMX systems boosts performance. On our tests, Premiere generated high-quality output for CD, tape, and Internet/intranet distribution.—*JM*
Adobe Systems Inc., San Jose, CA; 800-866-8006; www.adobe.com. (Reviewed: October 7, 1997, page 166.) Circle 468 on reader service card.

Business Diagramming

22 **Visio Professional 5.0**

Visio pioneered business graphics programs, letting those who

couldn't draw a straight line create professional-looking charts. Visio Professional 5.0 (\$350 street) expands on the popular standard package, adding 350 new networking and telecom shapes, as well as 75 new shapes for marketing diagrams such as pyramid and bubble charts. The hallmark of Visio Professional is automation: Smart connecting lines link shapes together, and if you add a new shape to an existing flowchart, for example, it automatically reroutes the lines around the new shape.—*JM*
Visio Corp., Seattle; 800-248-4746; www.visio.com. (Reviewed: March 25, 1997, page 48.) Circle 489 on reader service card.

Personal Finance

23 **Quicken Deluxe 6.0**

The upgrade that legions of loyal Quicken users have been waiting for, Quicken Deluxe 6.0, introduced a completely revamped interface for this popular personal finance program. New navigational aids make it easy to move among the program's various modules. But this new version was more than a face-lift: New Internet links, more supported banks, easier setup, a debt-reduction feature, a tax-deduction finder, and many other

improvements cement Quicken's leadership in this market.—*JM*
Intuit Inc., Mountain View, CA; 800-446-8848; www.quicken.com. (Reviewed: January 21, 1997, page 302.) Circle 490 on reader service card.

Applications Development

24 **Microsoft Visual Basic 5.0**

The most significant upgrade since Visual Basic 2.0, Microsoft Visual Basic 5.0 introduces such major enhancements as the integrated development environment (IDE), native code compilation, and a simplified process for writing code. Visual Basic is available in three main versions for building stand-alone applications: the Professional Edition (\$500 street), the high-end Enterprise Edition (\$1,200 street), and the low-end Learner's Edition (\$100 street). The most spectacular new feature is what Microsoft calls Intellisense, which eases the development process by providing intelligent assistance such as drop-down lists that display the properties of a given object. Visual Basic is the clear choice for a powerful yet easy-to-use programming environment.—*JM*

Microsoft Corp., Redmond, WA; 800-426-9400; www.microsoft.com. (Reviewed: August 1, 1997, page 66.) Circle 465 on reader service card.

navigation to a new level with the introduction of Explorer bars. Appearing as a vertical pane in the left side of your browser, an Explorer bar has four variants: Search, Favorites, Channels, and History. Other key enhancements include improved font management, more Web-centric printing options, and the slickest, most customizable interface imaginable. You have the option to install Active Desktop, which lets you extend the concept of the Web browser to the operating system. You can then browse folders on your hard disk the same way you surf the Web. You can convert your desktop folders and shortcuts to the single-click metaphor used on the Web.

IE4 adds a push client to its browser as well as to its off-line browsing capabilities. Again, the options for configuring the browser are unparalleled. For example, you can specify which files to download by type, select how much to download and how often, or simply let IE4 notify you when the contents of a site have changed.

With IE4, you also get Outlook Express, the best e-mail client released this year, the fastest Java virtual machine on Microsoft Windows, and the best implementation of Dynamic HTML.—*David Lidsky*
Microsoft Corp., Redmond, WA; 800-936-4400; www.microsoft.com. (Reviewed: November 18, 1997, page 100.) Circle 465 on reader service card.

Internet

Web Browser

25 **Microsoft Internet Explorer 4.0**

The browser that provides the best Web experience today and promises the best for tomorrow is Microsoft Internet Explorer 4.0. Whether you want a state-of-the-art browser, a very capable mail client, or best-of-breed conferencing tools, you'll find what you need with the free IE4 and its added components, Outlook Express and NetMeeting.

The IE4 browser takes Web

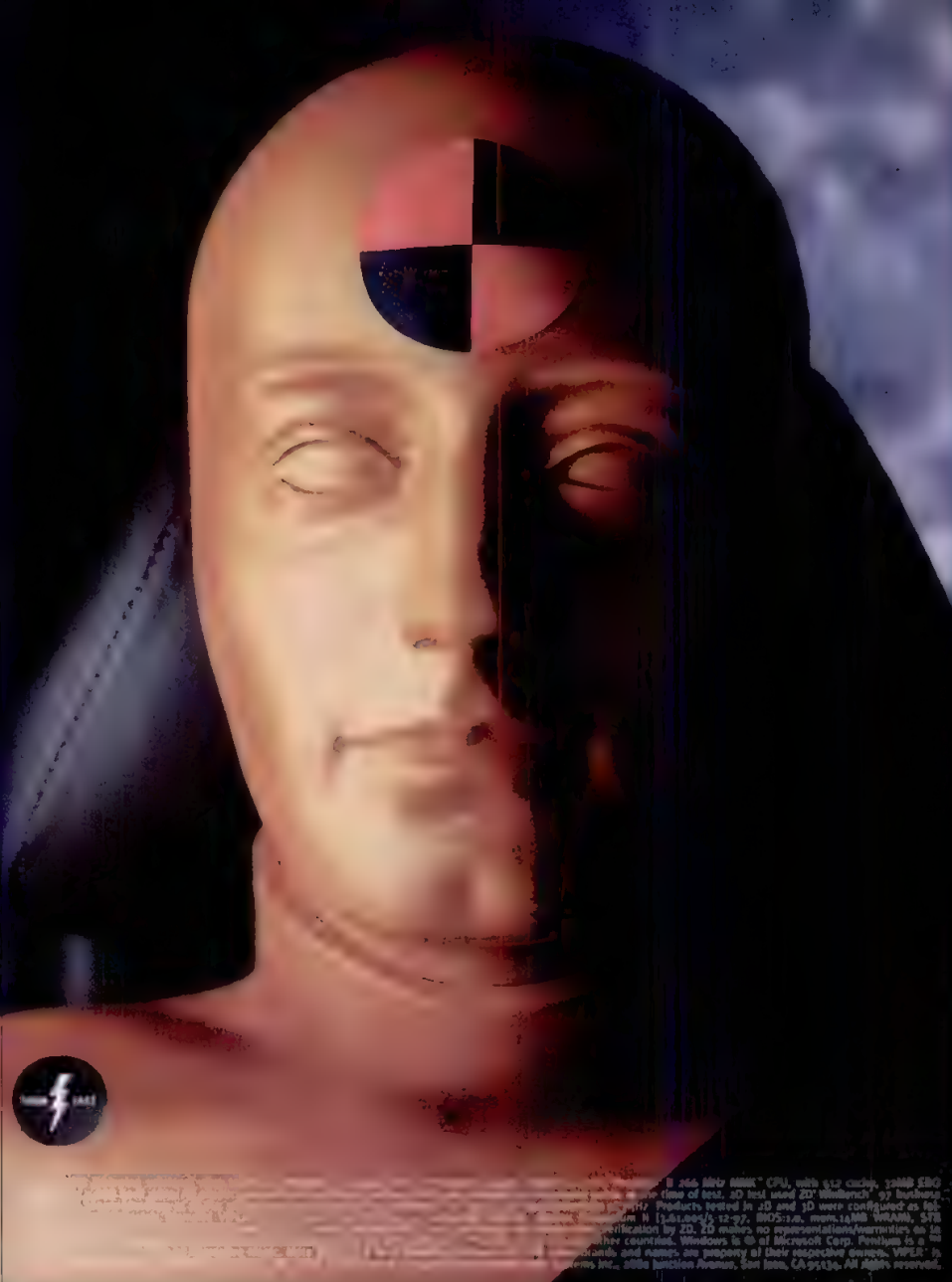
Web Server

26 **Microsoft Internet Information Server 3.0**

More than just a passable alternative to Unix-based Web servers, Microsoft Internet Information Server 3.0 is the preferred server for Windows NT—which may soon become the preferred platform for your intranets and external Web sites.

Internet Information Server is free with Windows NT 4.0, but it's





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26 continued

not just an afterthought to the operating system. First, you get an excellent array of tools to help you make your Web server a complete development platform. You can build dynamic Web pages with Active Server Pages (ASP) and perform Web page building and site management tasks with another "Best of the Year" product, Microsoft FrontPage 97. In addition, you get Crystal Reports for custom reporting, Index Server for advanced searching, and NetShow for on-demand multimedia. Together, these tools make creating and managing a powerful Web site much easier.

The Windows NT bundle is a great deal on Internet Information Server. It also lets the Web server take advantage of the operating system's administrative and security features. And not to be discounted, Internet Information Server truly shone on performance, making it suitable for the needs of any Web site.—DL

Microsoft Corp., Redmond, WA; 800-936-4400; www.microsoft.com. (Reviewed: May 27, 1997, page 187.) Circle 465 on reader service card.

Web Authoring

37 Microsoft FrontPage 97

The unequalled level of automation in Microsoft FrontPage 97 (\$149 list) makes it the HTML editor of the year. No other program made so much of the page creation process—including site management and dynamically created pages—so easy. In the FrontPage Editor, the changes you make on one page can be automatically applied to the rest. More advanced features are also surprisingly easy. You can design and implement animation sequences using the included Image Composer. And FrontPage's WebBot lets even beginners create discussion groups and forms without having to learn CGI scripts.

FrontPage 97's extras give it an edge. For example, FrontPage automatically converts graphics into Web-friendly files. When you're ready to publish your site, the program will determine whether or not your server supports FrontPage extension; if not, it automatically launches a Web Publishing wizard. By merging simple page creation with powerful features, FrontPage garners a "Best of 1997" spot in this rapidly evolving category.—Jennifer L. Anderson

Microsoft Corp., Redmond, WA; 800-426-9400; www.microsoft.com. (Reviewed: March 4, 1997, page 130.) Circle 465 on reader service card.

Search Engines

28 Yahoo!

Since its modest beginnings in 1994 as a simple categorized directory, Yahoo! has developed into an Internet powerhouse that is the place to start surfing the Web. Yahoo!'s extensively cross-referenced directory will help you find the perfect site, whether you're looking for information on acid jazz or marine archaeology. In addition, Yahoo! is a great Web destination in its own right, because the search service has added a diverse menu of tools and services.

We love Yahoo!'s news-searching capabilities. Searching for current news items not only delivers links to premium content sites such as CNN but also gives a complete portrait of each story, with links to relevant sites by category. And you can also sign up for My Yahoo!, a customizable news page tailored to your interests, or download a news ticker (whose content is also customizable) to run in your Windows 95 taskbar.

Yahoo! has also leveraged its database to launch several successful microsites such as Yahoo! Finance, regional guides, Yahoo!igans! For Kids, and Beatrice's Web Guide—a partnership with Women's Wire. More than just a place to access content, Yahoo! has added chat based on the

Editors' Choice-winning iChat Rooms and offers a free, browser-based e-mail service built using the popular RocketMail. Yahoo! recently acquired the Four11 directory, further bolstering its online offerings. As it continues to expand, Yahoo! is evolving into a starting point to the Web as well as a top-notch search site.—JLA
Yahoo! Inc., Santa Clara, CA; www.yahoo.com. (Reviewed: December 2, 1997, page 242.) Circle 491 on reader service card.

29 Northern Light

A new entry in a crowded field, the free Northern Light search service nevertheless stands out thanks to its remarkable searching capability. We found Northern Light uncanny in its ability to ferret out exactly what we were searching for, no matter how esoteric the subject—a trait that makes this service an invaluable research tool. The search site also filters out duplicate links better than most. Northern Light can automatically organize search returns by subject matter in Custom Search Folders. In addition to a database of indexed Web pages, it also offers material not available elsewhere on the Web for minimal fees of \$1 to \$4 per full-text article. Bookmark this site; we think it will get even better.—JLA

Northern Light Technology LLC, Cambridge, MA; www.nlsearch.com. (Reviewed: December 2, 1997, page 234.) Circle 492 on reader service card.

Filtering Utility

30 Cyber Patrol 3.1

A complete package for controlling children's Internet access and managing the time spent on the PC, Microsystems Software's Cyber Patrol 3.1 puts that power in the hands of parents. No other filtering utility offers this degree of control for both filtering and monitoring. Cyber Patrol categorizes Internet locations that are off-limits both by the type of application, such as



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Thumbs Up, Thumbs Down for 1997

THUMBS UP Apple's directors did The Right Thing when they removed Dr. Gil Amelio from the CEO slot. Amelio may have been a hero when he ran National Semiconductor, but he was a bum at Apple.

THUMBS DOWN Apple's directors did The Wrong Thing when they allowed the Ghost of Christmas Past, Steve Jobs, to walk the halls for months as a nonappointed CEO. Sure, Jobs has a lot to contribute. But letting a Non-Designated Meddler loose in Apple at the most critical juncture in the company's history wasn't very smart.

THUMBS UP IBM's Lou Gerstner made his money—conservatively speaking, \$30 million so far—the old-fashioned way: He made IBM work for it. Despite recent stumbles with overpriced Aptivas in the home-PC market, IBM has shown over Gerstner's four-year reign how it got to be IBM in the first place: strong products, great service, and clear vision. (Oops, sorry, Lou: We forgot for a moment that you don't think much of "the vision thing.")

THUMBS UP (with crossed fingers) Netscape's Jim Barksdale saw browser market share erode this year. But his strategic vision for the company has become clear, and it's a powerful one: first intranets, then extranets, then Internet-wide corporate connections and e-commerce. It's a big reach, but the guy who flew high at FedEx is one of the few people in the computer industry who can slug it out toe to toe with Bill Gates on strategy. Good luck, Jim.

THUMBS DOWN Microsoft's transparent plan to hijack Java is anticompetitive and antiuser. But Sun's Scott McNealy stepped into it again with his lawsuit alleging Microsoft's noncompliance with its Java license. This isn't a battle for the courtroom, Scott. If Microsoft can deliver a superior Java implementation in Windows, the war is over. Settle this by turning Java over to an independent standards group or it may become a footnote to computing history.

THUMBS UP Olympus and Canon continued to show the way for the digital camera business this year, pushing down into consumer territory image quality previously reserved for the pros. Kodak, meanwhile, despite CEO George Fisher's commitment and competitive nature, has lost \$500 million on its digital-imaging strategy. Memo to Rochester: Time's running out.

THUMBS UP The mass-storage industry gets a pat on the back for its relentless progress in pushing prices down and capacity up and up and up. With 6GB to 8GB drives now commonplace in new PCs—and 9GB the likely standard for 1998—we'll actually have enough room for Windows 98 and the next release of CorelDraw.

THUMBS UP Compaq's Presario 2200, the industry's first legitimate sub-\$1,000 computer, was one of the smash hits of the



By Jim Seymour

Netscape's Jim Barksdale is one of the few people who can slug it out with Bill Gates.

year, another example of the success of president and CEO Eckhard Pfeiffer's take-no-prisoners style. Now the problem for Compaq—and Dell, Gateway, Hewlett-Packard, and every other PC maker in the sub-\$1,000 market—is how to continue to grow a business with the frighteningly thin profits from these newbie wonders. Sometimes success carries within it the seeds of failure.

THUMBS DOWN Sure, the box says 56K, but don't count on getting that. In fact, unless your ISP supports one of the two competing 56K standards—

U.S. Robotics' x2 or Rockwell-and-the-rest-of-the-world's K56flex—you won't see better performance. One of the scandals of the business this year was that despite modem makers' ads touting hundreds or thousands of ISPs supporting their respective 56K technologies, many ISPs punted, waiting until 1998 to support *any* flavor of 56K connections.

THUMBS DOWN DVD disk drives should have been commonplace in PCs long ago, but bickering between drive makers and content providers has kept the notion of a universal DVD standard in flux. In August, Sony and NEC—both part of the consortium working on standardization—announced their own new proprietary, competitive, incompatible "standard." Then in September, electronic retailer Circuit City announced it was

funding a \$100 million effort by ZDS and Thompson (née RCA) to develop Divx, yet another competitive (and of course incompatible) DVD standard. So for another year, DVD remains in a holding pattern. Remember EVR? Betamax? DAT? The clock's ticking.

THUMBS DOWN Recordable DVD disks should also be spinning in our PCs by now. But thanks to the chaos of the DVD Forum, a trade group including Sony, Philips, Matsushita, Toshiba,

and Hitachi, confusion over which recordable DVD format will win still reigns. Worse, Forum members Sony and Philips have now joined with nonmember Hewlett-Packard to promote yet another new (and, need we add, incompatible) DVD-R format, DVD+RW. Coming next: The Keystone Kops DVD-R Forum will promote a DVD-R standard based on two-sided, erasable chocolate-chip waffles.

THUMBS UP Microsoft finally shipped Internet Explorer 4, a genuinely better browser.

THUMBS DOWN Microsoft stuffed Internet Explorer 4 full of clumsy, shallow, hard-to-remove push channels.

THUMBS DOWN Larry Ellison this year retained his trophy for crass behavior and pompous posturing. The highlight was his phony threat to lead a takeover of Apple. Retire to your mini-Japanese-village estate in Woodside, Larry. Let your teenage son fly around in the jet fighter you gave him for his birthday. Spend your billions. But please shut up.

30 continued

newsgroups, and by the type of unsuitable content, such as drugs. The monitoring application lets you track online and off-line activity and provides reports on how many times the program was shut down and avoided. Cyber Patrol can be purchased online for \$29.95 (list), and subscriptions to its Cyber NOT list of restricted sites or resources are \$19.95 for six months or \$29.95 for a year.—*John Morris*

Microsystems Software Inc., Framingham, MA; 800-828-2608; www.cyberpatrol.com. (Reviewed: April 8, 1997, page 237.) Circle 493 on reader service card.

Hardware

Personal Printers

Ink Jet Printer

31 Epson Stylus Color 800

Sales of personal ink jet printers



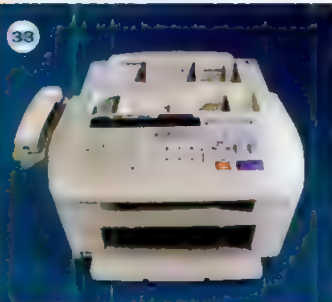
are exploding, and printers such as the Epson Stylus Color 800 (\$400 street) are the reason why. The Stylus Color 800 delivers excellent text output for business correspondence, eye-catching color for reports and presentations, and photographic printouts that could pass for actual photo enlargements—all at an affordable price. Rated at 8 pages per minute (ppm) for text and 7 ppm in draft mode for color, the Stylus Color 800 is quick enough for typical office chores. Epson's Micro Piezo ink jet technology and the printer's top resolution of 1,440 by 720 dots per inch (dpi) combine to deliver output quality unbeaten in this class.—*Jamie M. Bsales*

Epson America Inc., Torrance, CA; 800-463-7766; www.epson.com. (Reviewed: November 4, 1997, page 114.) Circle 476 on reader service card.

Laser Printer

32 NEC SuperScript 860

Business and SOHO users in the market for a fast and economical laser printer should look no further than the NEC SuperScript 860. Rated at 8 ppm, the SuperScript is actually faster than some 10-ppm laser printers we tested, thanks in



large part to its Adobe PrintGear printing-system architecture, which renders pages more quickly than other controllers. As you would expect, output from the 600-dpi laser engine is crisp and clear. And at just \$350 street, the SuperScript is a bargain among personal laser printers.—*JMB*

NEC Technologies Inc., San Jose, CA; 800-632-4636; www.nec.com. (Reviewed: November 4, 1997, page 159.) Circle 477 on reader service card.

Multifunction Printer

33 Brother MFC-7000FC

For many SOHO and corporate offices, a multifunction printer (MFP) is the way to go. The best one we've found is the Brother MFC-7000FC (\$1,000 street). This space-saving, all-in-one unit is built around a four-color ink jet print engine with a maximum resolution of 720 dpi. Add to that a 300-dpi color scanner (which allows you to make color copies as well) and a full-function monochrome fax machine and you have an office partner that can do it all—and well. Text output is near-laser-quality, and color output on coated ink jet stock is vibrant and rich.—*JMB*

Brother International Corp., Somerset, NJ; 800-827-6843; www.brother.com. (Reviewed: November 4, 1997, page 171.) Circle 478 on reader service card.

Network Printers

Laser Printer

34 Lexmark Optra N 245

If you have a workgroup to satisfy, you need a robust, network-ready

printer. For a monochrome laser workhorse, the Lexmark Optra N 245 (\$3,300 street with an Ethernet adapter) is the best new entry of 1997. The 24-ppm unit boasts all the paper handling a busy office could need, including tabloid-size (11- by 17-inch) and duplex printing, a paper sorter, and high-capacity input and output options. Setup and configuration on the network are easy, thanks to Lexmark's superb MarkVision administration utility. Output quality (600-dpi default, 1,200-dpi maximum) is the best in its class, and the Optra N 245 is one of the quickest laser printers we tested.—*JMB*

Lexmark International Inc., Lexington, KY; 800-539-6275; www.lexmark.com. (Reviewed: June 10, 1997, page 210.) Circle 479 on reader service card.

Color Laser Printer

35 Tektronix Phaser 560

The best network color laser on the market, the Tektronix Phaser 560 (\$5,000 street) is ideal for producing reports, presentations, brochures, and more. Its output quality (600-dpi resolution standard, 1,200-dpi maximum) is very impressive, the best we've seen yet from a color laser printer. Graphics have crisp edges, solid thin lines, and smooth gradients, and photos come close to true photographic quality. Rated at 14 ppm for monochrome and 5 ppm for color, the Phaser 560 is also one of the quickest color lasers available.—*JMB*

Tektronix Inc., Wilsonville, OR; 800-835-6100; www.tek.com. (Reviewed: October 21, 1997, page 136.) Circle 480 on reader service card.

Monitors

Business Monitor

36 Samsung SyncMaster 700b

A top-notch 17-inch monitor for corporate users, the Samsung SyncMaster 700b (\$530 street) is affordable for home and SOHO buyers as well. The SyncMaster



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36 continued

delivers 1,024-by-768 resolution at a flicker-free 85-Hz vertical refresh rate and a top resolution of 1,280-by-1,024 at 60 Hz. Image quality from the monitor's Invar shadow-mask tube (0.28-mm dot pitch) is excellent, with tight screen geometry, great focus, and rich, accurate color reproduction. It is easily one of the best general-purpose monitors for the price.—JMB

Samsung Electronics America, Ridgefield Park, NJ; 800-933-4110; www.sosimple.com. (Reviewed: October 7, 1997, page 144.) Circle 481 on reader service card.

Professional Monitor

37 iiyama VisionMaster Pro 17 For those who need a 17-inch monitor for more demanding chores such as desktop publishing, CAD, and image editing, the iiyama VisionMaster Pro 17 (\$670 street) is the best we've seen to date. Built around a Mitsubishi Diamondtron aperture-grille tube (with a 0.25-mm stripe pitch), the VisionMaster delivers 1,280-by-1,024 resolution at a rock-solid 85-Hz refresh rate, and it can support 1,600-by-1,200 resolution at an acceptable 72 Hz, which makes it ideal for high-res applications. Image quality is superb, and in our testing the unit

showed outstanding focus and color accuracy, especially for photographic images. The VisionMaster offers a full set of advanced on-screen image controls, and iiyama sells an optional four-port USB hub (\$130 street) for those looking to upgrade to USB down the line.—JMB
iiyama North America Inc., Costa Mesa, CA; 800-394-4335; www.iiyama.com. (Reviewed: October 7, 1997, page 135.) Circle 482 on reader service card.

21-Inch Monitor

38 Viewsonic PT813 Graphics professionals looking for a little more room should consider the Viewsonic PT813 (\$1,500 street). This 21-inch beauty features a Mitsubishi aperture-grille tube with a 0.28-mm mask pitch. The Viewsonic can deliver 1,600-by-1,200 resolution at an 85-Hz refresh rate. Brightness, color, resolution, and focus uniformity were all right on the money in our testing. The Viewsonic PT813 is an ideal display for image editors, Web designers, video editors, and CAD professionals.—JMB
ViewSonic Corp., Walnut, CA; 800-888-8583; www.viewsonic.com. (Reviewed: October 7,

1997, page 148.) Circle 483 on reader service card.

Graphics Accelerators

39 ATI All-in-Wonder Pro

If all you're getting from your graphics card is good Windows acceleration, you're missing out. The ATI All-In-Wonder Pro (\$280 street with 4MB of graphics memory, \$400 with 8MB) is a "convergence" board, designed to combine all the graphics needs of business and home users onto a single card. Thanks to the ATI 3D Rage Pro chip set, the card delivers excellent 2-D and 3-D acceleration for business and game applications. But good performance is just half the story. The All-In-Wonder Pro includes a built-in NTSC converter for displaying computer images on a standard television, plus a TV tuner (as well as an S-Video-in port and a TV-in cable connector) to give you the option of watching TV, a videotape, or a DVD-ROM on your PC. The included Video Player applet has a channel scanner that displays thumbnail previews of available channels, full-motion instant replay, and a closed-caption capture utility that can create a transcript file.—JMB
ATI Technologies Inc., Thornhill, Ontario; 905-882-2600; www.atitech.com. (Reviewed: December 2, 1997, page 270.) Circle 484 on reader service card.

Scanners

SOHO and Small Business

40 Logitech FreeScan

The Logitech FreeScan (\$300 street) may look like an ordinary

sheet-fed scanner, but this compact unit is a true powerhouse that meets all the text- and color-scanning needs of a typical business or SOHO user. The sleek device houses a 600-dpi, 30-bit color scanner whose output quality matches that of typical flatbed scanners. Even better, the 30-page document feeder makes scanning text documents much more convenient than on a flatbed, and the detachable scan head can be used for books and other bulky items. Logitech includes DocuMagix's PaperMaster and Xerox's TextBridge for document management and optical character recognition (OCR), plus the image-editing software Adobe PhotoDeluxe.—JMB
Logitech Inc., Fremont, CA; 800-732-3039; www.logitech.com. (Reviewed: November 4, 1997, page 238.) Circle 485 on reader service card.

Professional Graphics

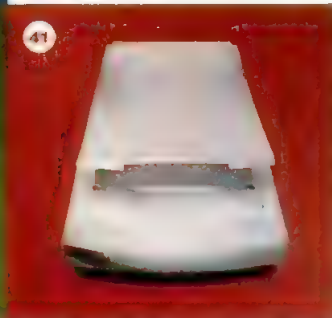
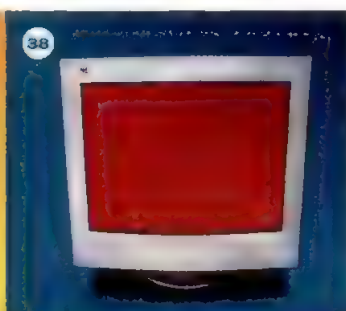
41 Microtek ScanMaker III

For professional graphics, few scanners are as robust as the Microtek ScanMaker III (\$1,500 street) or offer better image quality. Like the Logitech FreeScan, the ScanMaker boasts a 600-dpi optical resolution, but its 36-bit color depth means it can capture a much fuller range of light and shadow. Images are sharp and crisp, colors correctly saturated and accurate. Microtek's Twain driver, ScanWizard, includes a bevy of prescan tools and corrections that are easy to understand and use, and the ScanMaker bundle includes a full version of Adobe Photoshop and a transparency adapter.—JMB
Microtek Lab Inc., Redondo Beach, CA; 800-654-4160; www.microtekusa.com. (Reviewed: March 4, 1997, page 186.) Circle 486 on reader service card.

Storage

42 SyQuest SyJet

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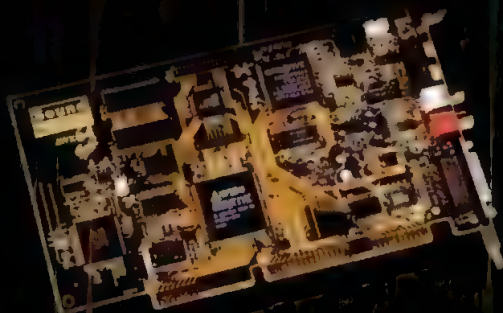
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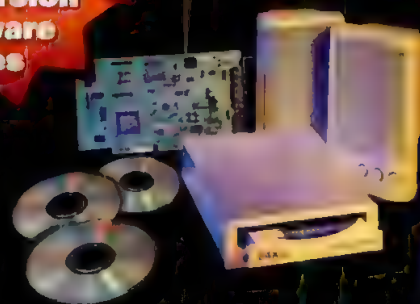
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2x PC-DVD**

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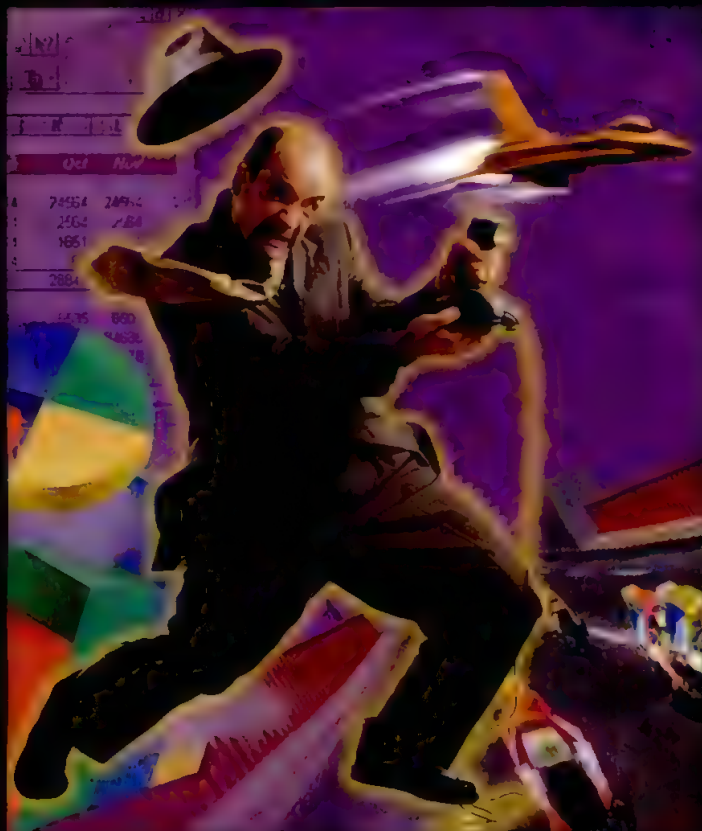
WWW.SOUNDBLASTER.COM

*Estimated Street Price

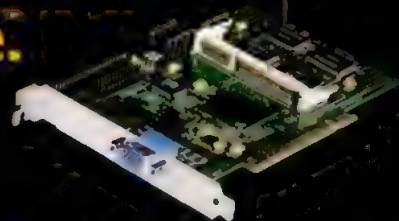


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Mind-Blowing Acceleration & Eye-Popping Graphics.



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Break the barrier in PC graphics performance with the new Graphics Blaster® Exxtreme™ from Creative Labs. Blast through the coolest games. Punch up your presentations. Be more productive. With up to 8MB of memory and state-of-the-art display technology, the Graphics Blaster® Exxtreme™ provides ultra-high resolutions, millions of colors and vertical refresh rates that deliver brighter, more vibrant images. With built-in upgrade capabilities, including support for our revolutionary new DynamicXtended Resolution™ (Dxr2™) enhanced DVD playback technology, the PC you have today can take you into the future. **Want the Coolest PC?** Visit us at www.coolestpc.com or call 1.800.998.5227.

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- High-speed 230MHz DAC, with refresh rates up to 220Hz
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- Upgradeable to Creative's Dxr2™ enhanced DVD playback module, including TV output
- Supports resolutions up to 1600X1200 and up to 16.7 million colors



The Hottest Upgrades Create the Coolest PC.™

*Estimated Street Price

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42 continued

device can help with the finances, but the SyQuest SyJet (\$300 street) certainly takes care of the latter. Based on the same Winchester technology as your PC's hard disk, the SyJet gives you hard disk performance in removable 1.5GB cartridges (\$130 each) that serve well for backup or for supplementary storage. The SyJet is optimized for multimedia applications, with a minimum 3.7-Mbps sustained transfer rate and 512K cache. The high-performance SCSI version is ideal for developers, for graphics designers, and for workstation backup; for the rest of us, a parallel-port version trades raw speed for ease of installation.—JMB
SyQuest Technology Inc., Fremont, CA; 800-245-2278, www.syquest.com. (Reviewed: May 6, 1997, page 195.) Circle 487 on reader service card.

Networking

Network Operating System

43 Microsoft Windows NT Server 4.0

Microsoft's strategy for Windows NT Server 4.0 has been to lay a solid foundation and build up from

there, brick by brick. The result is a tower of networking power. Beneath the familiar Windows interface, Windows NT Server 4.0 boasts some sophisticated and well-integrated services, including Internet Information Server (IIS) 2.0 for Web, Gopher, and FTP services and an excellent Internet Service Manager tool.

Remote access and multi-protocol routing add flexibility, while an index server and the bundled Web authoring tool Microsoft FrontPage add utility. The list of Windows NT services and utilities offered by other vendors seems endless. Although the enterprise-wide directory-naming service isn't in place yet, Windows NT (\$810 street for a single-server license and five clients) is otherwise a nicely designed package.—Frank J. Derfler, Jr.

Microsoft Corp., Redmond, WA; 800-426-9400; www.microsoft.com. Circle 465 on reader service card.

Groupware

44 Lotus Domino 4.5

Lotus Domino 4.5 is the groupware package that serves up the Internet on a platter. A collection of server products, Domino works with the full Notes client or with the scaled-down Notes Desktop and

Notes Mail clients. Domino performs database replication, indexing, and mail routing, and it provides the valuable document-oriented, rich-text, flat-file message store of Notes. Any user with a Web browser can access Domino applications, though the more sophisticated capabilities are available only with the proprietary client.

Applications development is another major strength of Domino. Its strong BASIC-like scripting language LotusScript and ActiveX integration make Domino a rich development environment. Street pricing for Domino starts at \$1,500 per server plus \$55 per client.—FJD

Lotus Development Corp., Cambridge, MA; 800-346-1305, 617-577-8500; www.lotus.com. Circle 466 on reader service card.

IP Address Management

45 IP Management System

Ideally, a network manager should have to set up an IP address scheme only once in a professional lifetime. If your turn is about to arrive, or if you're unfortunate enough to have to do the job again, Quadritek Systems' IP Management System (QIP) can be your salvation. It helps you run large networks of IP addresses, sort out subnets, and plan for the increasingly popular virtual networks. This product maintains a central database (using Microsoft SQL Server or Sybase) of your network addresses, and it pushes new configurations and changes out to servers. Initially available only for

Unix, QIP is now available for Windows NT as well. QIP costs from \$2 to \$5 per IP address, but it's well worth the investment.—FJD
Quadritek Systems Inc., Malvern, PA; 888-683-2254, 610-725-8535; fax, 610-725-8559; www.quadritek.com. Circle 467 on reader service card.

ISDN Adapters

External Adapter

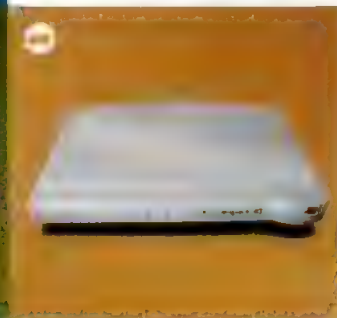
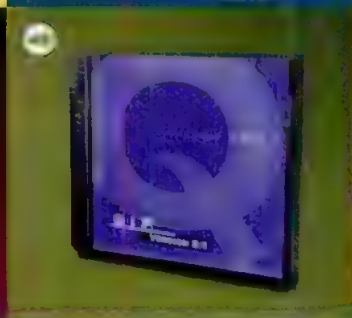
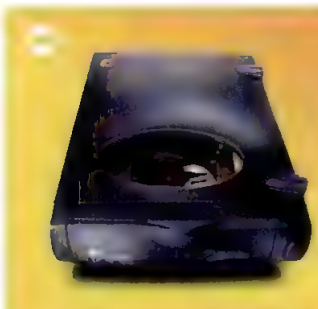
46 3Com Impact IQ External ISDN Modem

Our product recommendations are based on extensive testing. Nevertheless, seldom can we make a recommendation with such confidence. Simply put, the 3Com Impact IQ External ISDN Modem (\$250 street) is the best external ISDN adapter available. The original Impact was mediocre, but 3Com Corp. got it right the second time with the IQ version. A solid performer with two analog ports, a painless installation routine, and a full suite of software, the Impact provides the most bang for the buck in a competitive field. 3Com includes a free ISDN line-ordering service and SPID (Service Profile Identifier) Wizard installation software, which automatically sorts out many of the arcane details of ISDN. With the Impact, you get all of the bells and whistles of any other ISDN modem without the usual installation woes.—FJD
3Com Corp., Santa Clara, CA; 800-638-3266; www.3com.com. Circle 474 on reader service card.

Internal Adapter

47 Diamond Supra NetCommander ISDN

External ISDN modems suffer from the throughput limitations of the serial port, so many users opt for internal ISDN terminal adapters. The Diamond Supra NetCommander ISDN offers Windows 95 Plug and Play, a full-featured analog port, excellent performance, and innovative software—all at a show-stopping street price of \$230. Diamond also offers an ISDN line-ordering service to help users



YOU'RE A BUSINESS PERSON.



HE'S NOT.



SO... WHY ARE YOU USING THE SAME MODEM?



Get the 3Com Courier V. Everything Business Modem. It Means Business.

With 3Com Courier V.90, you get the fastest modem available today. And you get a modem that's built for business. It's the only modem that's been tested and rated by PC Digest, CNET, and PC World as the best business modem available.

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With 3Com Courier V.90, you get a modem that's built for business. It's the only modem that's been tested and rated by PC Digest, CNET, and PC World as the best business modem available.

"The fastest modem (and) also our top-rated-product." — *PC Digest*

"No matter how hard we tried, we couldn't get these modems to drop out or fail to connect."
— *CNET*

*Maximum download speeds are limited to 53 Kbps. Actual speeds may vary. Uploads travel at speeds up to 28.8 Kbps. Requires an analog phone line compatible with V.90 technology and an Internet provider with x2 service. See www.3com.com/x2 for details.

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From the leader in networking.





47 continued

set up service and Internet access. Diamond's AutoISDN software displays each B-channel graphically to make up for the internal device's obvious lack of activity lights. AutoISDN also provides a useful connection log as well as configuration and diagnostic tools. The NetCommander achieves file-transfer speeds of more than 280 Kbps thanks to compression on both single- and dual-B-channel connections.—FJD

Diamond Multimedia Systems Inc., San Jose, CA; 800-727-8772; www.diamondmm.com. Circle 469 on reader service card.

RAID Array

48 Aiwa LightningArray RAID

You pay a premium for performance and reliability in servers. The Aiwa LightningArray RAID subsystem is a case in point. It handles up to 45GB of data with high speed and resiliency. The system offers RAID Level 3 and Level 5 data protection, redundant swappable power supplies, and sophisticated management software.

Aiwa provides a dual SCSI bus that lets users attach two separate PCs to the same subsystem. The management software is very powerful and includes a Perfor-

mance Monitor that gives a graphical view of all drives and their status under DOS, Microsoft Windows 3.x, Windows NT, or OS/2. It also has options for cache setup, rebuilding drives, and configuring system alerts. All of this doesn't come cheap—a total system will cost about \$20,000—but you get one of the best RAID arrays available today.—FJD

Aiwa America Inc., Irvine, CA; 800-289-2492; www.aiwa.com. Circle 470 on reader service card.

ISDN Router

49 Cisco 1604

Single-line routers are useful, but growing networks need more connectivity. Cisco Systems' 1600 series of routers offer flexibility and scalability. The Cisco 1604 (\$1,500 list) comes with one basic-rate ISDN port and one flexible expansion slot. The expansion slot can host an additional ISDN interface or an async/sync serial interface. The second ISDN port appeals to users who need more bandwidth than a single ISDN line can provide, while the serial interface provides a hedge against obsolescence.

The 1600-series routers use Cisco's industrial-strength Internetwork Operating System (IOS). But IOS can be intimidating, so

Cisco provides a point-and-click user interface for the 1604. The browser-based interface runs as a small HTTP server on the router, so you can install, configure, and monitor the router from any browser.—FJD

Cisco Systems Inc., San Jose, CA; 800-553-6387; www.cisco.com. Circle 471 on reader service card.

Remote-Access Servers

50 Shiva LANRover Access Switch

Few organizations work in just one place anymore, so remote-access switches have become a business necessity. Shiva Corp. was the first to solve most of the remote-access problems, and it still delivers the best solutions. The Shiva LANRover Access Switch was the top performer on our tests. The system offers client-side caching to speed throughput, tariff management to control costs, dial-in, dial-out, and LAN-to-LAN routing for flexibility. The Shiva Access Manager software provides authentication, accounting, and authorization. This enterprise-level switch can scale to handle 90 simultaneous connections on a single chassis. Prices range from \$14,440 for 90 ISDN connections to \$50,100 for 90 analog and ISDN connections and

7256K modems.—FJD

Shiva Corp., Bedford, MA; 800-847-4482; www.shiva.com. Circle 472 on reader service card.

56-Kbps Modems

K56flex

51 Diamond SupraExpress 56i Sp

Work on a single standard for 56-Kbps modems will continue well into 1998, so for now the standard your ISP or your company uses should determine what you buy. For buyers of K56flex modems, we suggest the Diamond SupraExpress 56i Sp (\$140 street) as the best mix of performance, features, and value.—FJD

Diamond Multimedia Systems Inc., San Jose, CA; 800-727-8772; www.diamondmm.com. Circle 469 on reader service card.

x2

52 3Com Sportster 56K Faxmodem

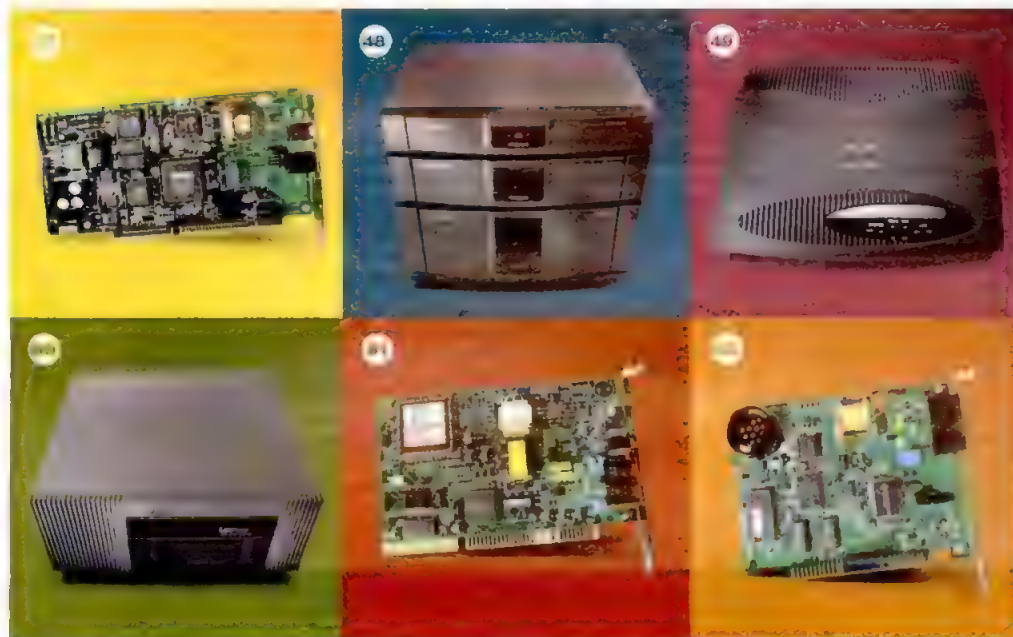
For those who are going to connect with an x2 host, the 3Com Sportster 56K Faxmodem is our choice (\$200 street for the internal version). The SupraExpress turned in excellent performance scores, has all of the basics, and includes VDOLive—all at a very competitive price. The Sportster line has proven value, impressive test scores, and a generous software bundle. The Sportster products should easily upgrade to the new standard software when it is available.—FJD

3Com Corp., Santa Clara, CA; 800-342-5877; www.3com.com. Circle 469 on reader service card.

Midsized Hub

53 3Com SuperStack II PS 50

A port-switching hub is a slightly arcane but very smart piece of hardware. For \$75 per port (\$1,799 list), the 3Com SuperStack II PS 50 provides 24 10Base-T ports, an optional 100-Mbps port, four internal LAN segments, extensive browser-controlled management, and a built-in Ethernet switch. This hub, part of the scalable SuperStack II family, automatically seg-



9:23 a.m.
Check stocks. Market up.

11:16 a.m.
Check stocks. Market way up.

1:33 p.m.
Check stocks. Market way, way up.

1:34 p.m.
Surf car websites.

16 gray-scale backlit screen

60-column full-width screen

8MB memory

Wireless e-mail and Internet access
via optional PC card modem*

Designed for



Microsoft®
Windows CE

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With its crisp, higher resolution screen,
the HP 360LX Palmtop PC lets you do
anything: send e-mail, surf the net, run
spreadsheets, handle word processing,
update your calendar. Any time, any place.



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capture of live video and
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VideoBrush™ software allows
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controller brings 3D capabilities
to a notebook and up to 60%
faster 2D performance.

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standard battery life —
and up to 7 hours, using an
optional second battery
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LANDesk™ Client Manager 3.0 for
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ultimate computing experience.

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decoding, Dolby™ AC3 Digital
surround sound support
and 3D graphics make your
multimedia presentations
come alive. DVD can
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of reference material
all on a single disk.

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Get plenty of storage
capacity with the 4.77GB
standard HDD and optional
3.82GB second HDD
in the SelectBay.

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Introducing the new Tecra™ 750DVD, the ideal notebook for the most demanding power user. Who else but Toshiba, the world's leader in portable technology, could pack so much performance, storage capacity and multimedia support into one notebook? No matter how complex your application requirements or how advanced your mobile computing needs, this notebook will give

you the power and performance you need to be successful. There are also plenty of docking and memory expandability options, plus the very latest network management tools to deliver the ultimate computing experience. Best of all, the Tecra 750DVD is backed by the superior quality, reliability and service you need to **Always Lead.™**

TECRA 750DVD

- 64MB high-speed EDO DRAM (expandable to 160MB)
- DVD-Video playback*, up to 15.9GB of DVD-ROM storage, CD-R compatible

TECRA 750CDM

- 32MB high-speed EDO DRAM (expandable to 160MB)

BOTH MODELS

- Built-in MPEG II hardware support
- High-speed 4MB Video RAM
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- Supports two Type II or one Type III 16-bit PC Cards, ZV Cards or 32-bit CardBus Cards

- SelectBay slot supports CD-ROM, floppy disk drive, optional 3.82GB second hard drive, optional second Lithium Ion battery or DVD-ROM drive (optional on 750CDM)
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CIRCLE 377 ON READER SERVICE CARD

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53 *continued*

ments your network nodes to balance the load. You can configure any of the switched ports to serve as redundant fail-over connections. If a port connected to an important device such as a file server fails, the redundant port will automatically take over without losing data. The SuperStack II delivers peace of mind and optimal performance.—FJD

3Com Corp., Santa Clara, CA; 800-638-3266; www.3com.com. Circle 474 on reader service card.

Utilities

Antivirus

54 Norton AntiVirus 2.0 for Windows 95

In today's Internet- and e-mail-crazed world, your chances of encountering a virus are much greater. Norton AntiVirus 2.0 for

Windows 95 (\$50 street) is a powerful antidote. Norton AntiVirus catches all the viruses you're most likely to come across, including those seemingly ubiquitous macro viruses. The list of file types that Norton AntiVirus scans by default is one the largest among antivirus programs. Wizards guide you through scanning and disinfecting chores, and Symantec's LiveUpdate feature makes it simple to upgrade virus-definition files, free for the life of the product.—John Morris
Symantec Corp., Cupertino, CA; 800-441-7234; www.symantec.com. (Reviewed: April 8, 1997, page 109.) Circle 460 on reader service card.

Diagnostics

Reporting and Diagnostics

55 WINProbe 95

Quarterdeck Corp. completely retooled WINProbe in 1997,

delivering a system utility that offers impressive reporting capabilities, solid diagnostics, system tune-up, and crash protection in a single package. WINProbe 95 (\$50 street) generates reports on currently running modules and some advanced Windows system information. The crash-protection module passed our 16- and 32-bit page fault tests. The utility also includes some nice extras, such as the ability to trim obsolete Registry entries and the ability to display thumbnails in place of icons for .BMP files.—JM
Quarterdeck Corp., Marina del Rey, CA; 800-683-6696; www.quarterdeck.com. (Reviewed: April 8, 1997, page 125.) Circle 461 on reader service card.

Tune-Up and Troubleshooting

56 First Aid 97

CyberMedia pioneered software troubleshooting and conflict resolution with the original First Aid. The latest version, First Aid 97 (\$35 street), is even stronger medicine for what ails your PC. Its nonstandard yet elegant interface offers system tune-up, crash protection, and conflict resolution. Features that set it apart include the ability to identify and fix corrupted Registry entries and a knowledge base covering more than 1,000 applications. First Aid 97 can track and undo system file changes, and its excellent crash-protection module passed our 16- and 32-bit tests and successfully unfroze a crashed application. An adviser module suggests solutions to system problems.—JM
CyberMedia Inc., Santa Monica, CA; 800-721-7824; www.cybermedia.com. (Reviewed: April 8, 1997, page 125.) Circle 462 on reader service card.

Network Backup

57 ARCserve 6.0 for NetWare/for Windows NT

The most extensive and flexible network backup solution for

multiserver environments, Computer Associates International's ARCserve 6.0 for NetWare (\$1,895 list) and ARCserve for Windows NT (\$1,395 list) offer a host of options such as virus protection, hierarchical storage management, RAID, and agents for almost every operating system on the market. Both the NetWare and Windows NT versions of ARCserve are very easy to set up, and their management utility interfaces are similar. Agents automatically push backup data from client PCs to a server in ARCserve format. Most of the modules are also sold separately.—JM
Computer Associates International Inc., Islandia, NY; 800-243-9462; www.cai.com. (Reviewed: April 8, 1997, page 188.) Circle 463 on reader service card.

Uninstaller

58 CleanSweep 3.0

The most thorough uninstaller on the market, Quarterdeck's CleanSweep 3.0 (\$40 street) keeps a tidy hard disk. CleanSweep monitors program installations in the background, and the utility can completely uninstall an application or folder, whether or not it monitored the original installation. In addition to its wizard-driven uninstall module, CleanSweep includes easy-to-use file cleanup modules for clearing out obsolete or redundant files, an intelligent Registry editor, and a utility that allows you to archive an application or transfer it between drives or even between PCs. Since our review appeared, Quarterdeck has issued a patch that clarifies the functions of the utility's new SafetySweep feature, making CleanSweep a safe and highly effective uninstaller.—JM
Quarterdeck Corp., Marina del Rey, CA; 800-683-6696; www.quarterdeck.com. (Reviewed: April 8, 1997, page 138.) Circle 461 on reader service card. **PC**



The 1997 ARF Awards

Most Apocalyptic TV Commercial

In a commercial flaunting the speed of the AMD K6 CPU, an oil truck in flames devastates a city as a yuppie sends his e-mail message fast enough to get out of the way and survive the disaster. Meanwhile, countless others perish. The feel-good ad of the year.

Swiftest Laser

Gary Kasparov, coughing up time excuses after IBM's Deep Blue trounced him in chess.



Strangest Marketing Strategy

CompuServe announced that in an attempt to reach a more upscale, less trendy audience, it would start advertising in map stores.

Most Awkward Moment

On May 19, Digital executives who gathered at New York's Comedy Nation were treated to a show by "Saturday Night Live" cast member Tracy Morgan, whose foul-mouthed stand-up routine included the question: "What, don't you people from Digital have sex? Sure you do. I can tell you do."

Most Annoying Buzzword of the Year

Scalability
Second Most Annoying Buzzword of the Year
Total cost of ownership

The Best of Abort, Retry,

Worshipping False Idols

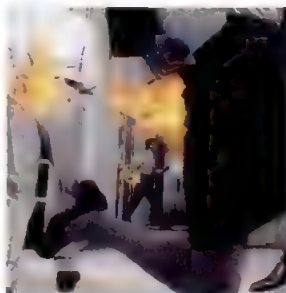
Of all the doodads and tchotchkes we received this year, none were cuter than the three Office Gods from Talus (800-634-8180), to which we prayed regularly. There's **Compu**, the goddess of successful computing; **Stressa**, who calms you down in times of crisis (she's our favorite); and **Surfus**, the god who keeps your browser from crashing. He even comes with his own poem:

*When Web waits stretch ad infinitum
And the info you want's out of sight-em
Just search the domains
Where your Web god reigns
And Surfus will deliver your item!*



Advertisement of the Year

Hitachi PC Corp. thought it was advertising notebook PCs, but to us, this looked much more like an ad for either **Preparation H** or a Mexican restaurant.



Renaissance Man of the Year

Marshall Applewhite: music professor, opera singer, husband, cult leader, and Webmaster.



Fail?

MMMBop! What a year! Mergers! Successes! Failures! Browser updates! Web cults! On and on we toiled, but in the end, Bill made all the money.

BOSSSES OF THE YEAR AWARDS For Managerial Excellence



*To Netscape's
Marc Andreessen*

In *Rolling Stone* magazine, Andreessen said, "I don't want to run a company. I'm **not good** at managing people. You have a problem with the guy in the next cubicle? I don't care. **Shoot him or something.**"

For Best Appreciation of Stock Options

To Time Warner's Ted Turner

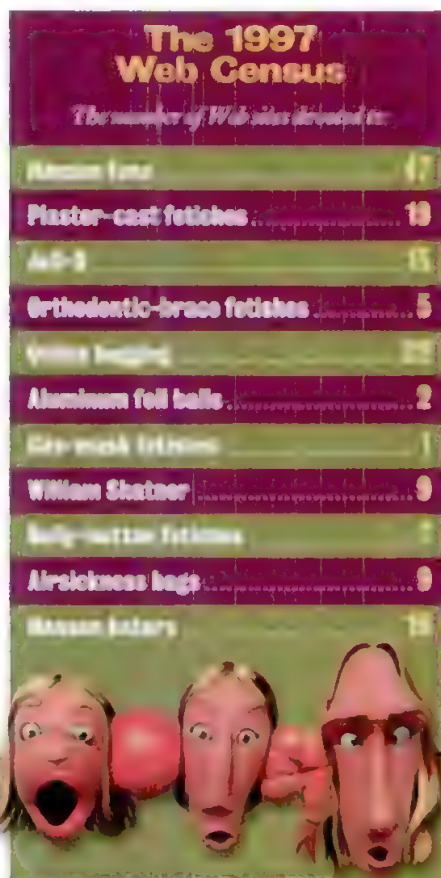
At Spring Comdex, Turner said, "I have my own computer on my desk with our stock and all the other stocks, and you know, every few seconds it changes, up one-eighth, down one-eighth, and it's kind of like playing a **slot machine**. Thank God I've got it behind me. If it was on my desk I'd be so stuck to it. It's hypnotizing. You know, you lose \$20 million, you gain \$20 million. Can I afford to pick up the **lunch check**, or do I have to stick whomever I'm having lunch with [with] the check?"



For Best Use of Videoconferencing

To Apple's Steve Jobs

On August 6, Jobs stepped onto a stage at Boston's Macworld Expo to announce Microsoft's \$150 million investment in Apple. As he spoke, Bill Gates beamed in from Seattle on a **20-foot-high** video screen, spooking the 1,600 Mac fanatics in attendance with the single most disquieting moment of **Orwellian imagery** in personal computing history.



Worst Reason to Cancel a PC Magazine Subscription

On May 27, one reader pulled the plug on us after he saw a Minolta printer ad featuring Dennis Rodman in the magazine.



Most Obtuse Description of a Web Site
Here's how Timothy Schwartz describes his site, Caesar's Palace of the Antipathetic (<http://www.mindspring.com/~Franklinprinting/caesar/>): "A collection of the things against normal views of society itself. Howard Stern pages. Anne Rice pages. My views on certain issues. Essays describing my views. One of the most interesting sites on the Internet."

"With Friends like These" Award
Jeff Bezos, founder of the successful online bookstore Amazon.com, is doing his part to drive independent bookstores into extinction, but he says he does half his book shopping at bookstores in "the physical world," because he "likes the ambience."



The

Shi

positional audio

Soundsc

By
Ken C.
Pohlmann and
Will Pirkle

Consider the following piece of consumer electronic equipment: a plastic box with a few user-friendly controls, a microprocessor and memory, an optical disk drive, and high-fidelity sound output. Depending on your bias, you might identify the box as either a CD player or a personal computer. Both answers could be correct.

Although the consumer audio industry started back when Edison shouted at a piece of tinfoil, the consumer PC industry is relatively young. But the same explosive growth of low-cost digital technology that engendered the PC also revolutionized the otherwise-mature audio industry.

Today, both industries are working together, exchanging technologies—with each improving the other. The audio industry has contributed technologies such as the CD, DVD, 3-D audio, and sound synthesis. The computer industry has chipped in with the PCI bus, AC '97, audio APIs (application programming interfaces), and USB. The only downside is the complexity of the many audio options available to PC users.

IN THIS REVIEW

In this story, we'll address some of the most important changes in the PC audio landscape

fitting

physical model



ape

There are new ways to implement sound on the PC. We look at the emerging technologies and test the latest sound boards and speakers.

pci sound board



In this review

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PCI SOUND BOARD

ISA Audio Gives Way to PCI

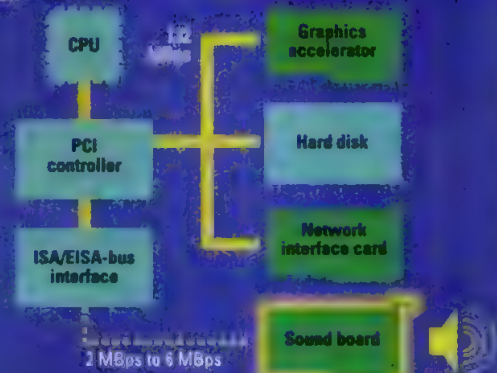
ISA Sound Board Configuration

PROS

- Low cost to implement
- Proven reliability
- Compatibility with Sound Blaster legacy applications

CONS

- Low bandwidth limits audio functionality
- Uses up precious IRQs and DMAs
- Limited to 85-dB signal-to-noise ratio



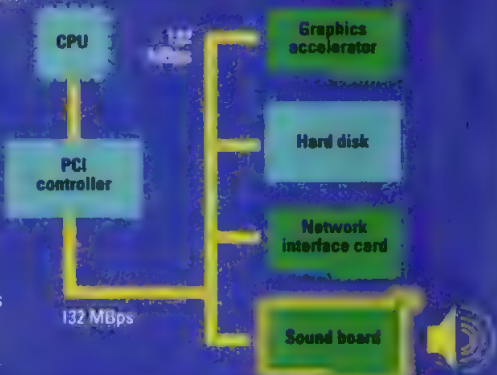
PCI Sound Board Configuration

PROS

- Higher bandwidth allows better audio effects (16 stereo streams, positional audio)
- Less resource-intensive
- Allows 90-dB signal-to-noise ratio or better
- Allows phaseout of ISA bus

CONS

- Higher initial cost to manufacturers
- Sound Blaster compatibility must be implemented via a workaround



that will affect both business users and PC hobbyists:

- the emerging use of the PCI bus for sound boards and motherboard audio;
- new audio APIs such as DirectSound and DirectMusic, and design specifications such as AC '97;
- positional audio algorithms and the arrival of true surround sound on the PC;
- the new sound-synthesis technique of physical modeling;
- the arrival of USB audio and what it enables.

We follow this technological overview with reviews of the latest sound boards and speakers from the largest players in the industry.

Our Contributors: KEN POHLMANN and WILL PIRKLE are professors of music engineering at the University of Miami School of Music in Coral Gables. DON LABRIOLA is a contributing editor of *PC Magazine*. CRAIG L. STARK is a frequent contributor to the magazine and a contributing editor of *Stereo Review*. JAMIE M. BSALES was the associate editor in charge of this story, and ZD Labs senior project leader KURT STOEHR was the project leader.

MOVING FROM ISA TO PCI

Early PCs lacked the speed required to process an audio signal. It wasn't until the late eighties that sound boards let PC users hear more than simple beeps.

The older ISA bus (see the diagram above) was hardly up to the task. With a bandwidth of 2 to 6 MBps, ISA truly was a bottleneck when it came to audio. A stereo-CD data stream at 1.4 MBps, along with sound effects and a MIDI voice or two, could easily consume 40 percent of the bus's bandwidth—leaving precious little capacity for the operating system. In contrast, the PCI bus, with its 100-MBps bandwidth

(or higher), is lightly taxed even with multiple audio streams running concurrently.

Moreover, audio output must be free of any interruptions in the flow of audio data. Because of its high performance, the PCI bus allows *cooperative signal processing*, in which tasks are balanced between the host processor and an audio accelerator. For these and other reasons, the PCI bus will replace the ISA bus in short order. In fact, Microsoft's PC 98 specification decrees that Microsoft certification logos shall not be issued to ISA-based audio solutions after January 1, 1999. One serendipitous aftereffect of the migration is that it will allow PC makers to phase out the ISA bus altogether, which should lower the total system costs.

One potential stumbling block to the ISA-to-PCI shift is the question of compatibility with legacy DOS applications, primarily game applications. Sound board protocols such as those for the popular Sound Blaster standard require ISA bus features such as direct memory access (DMA) and interrupt request services (IRQs) to move audio from memory.

Alas, the PCI bus does not support these legacy features directly, and supporting legacy audio under PCI is a challenge for audio designers. There is a danger that many existing applications might not run once the ISA bus is abandoned.

The PCI standard does, however, support its own inter-

rupt definitions with four unique interrupt-request lines (INTA, INTB, INTC, and INTD), and these lines can be steered into legacy space through special hardware that redirects them to standard ISA

IRQ lines. The DMA problem is being solved by the introduction of two different workarounds that provide legacy DMA support on the PCI bus: distributed DMA (DDMA) and PC/PCI enhancements to the PCI bus protocols. Intel specifically recommends the PC/PCI solution for motherboard PCI audio chips lacking legacy Sound Blaster compatibility. Thus, sound board and audio chip set makers can deliver DOS support in PCI implementations.

How good are your speakers and sound board? The interactive version of "The Shifting Soundscape" features files that let you test them and see for yourself.

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BETTER EXTERNAL BUSES

High-bandwidth audio has always taxed internal bus architectures, and PCI nicely addresses that issue, but there is still need for improved external buses. In particular, the Universal Serial Bus (USB) and the IEEE 1394 bus (also referred to as FireWire) are extremely well suited to audio and other multimedia applications.

The Universal Serial Bus is designed to replace today's serial (and parallel) I/O buses. USB's transfer rate of 12 Mbps (megabits per second) is much faster than the tortoiselike 115-Kbps speed of serial ports. Moreover, USB can support up to 127 devices in a plug-and-play chain, and devices can be hot-swapped without powering down the system. USB uses a tiered-star topology in which only one device, such as a monitor, must be plugged into the PC; the bus then acts as a hub to which additional devices can be connected with 16-foot cable runs. USB can also be used to drive low-power peripheral devices.

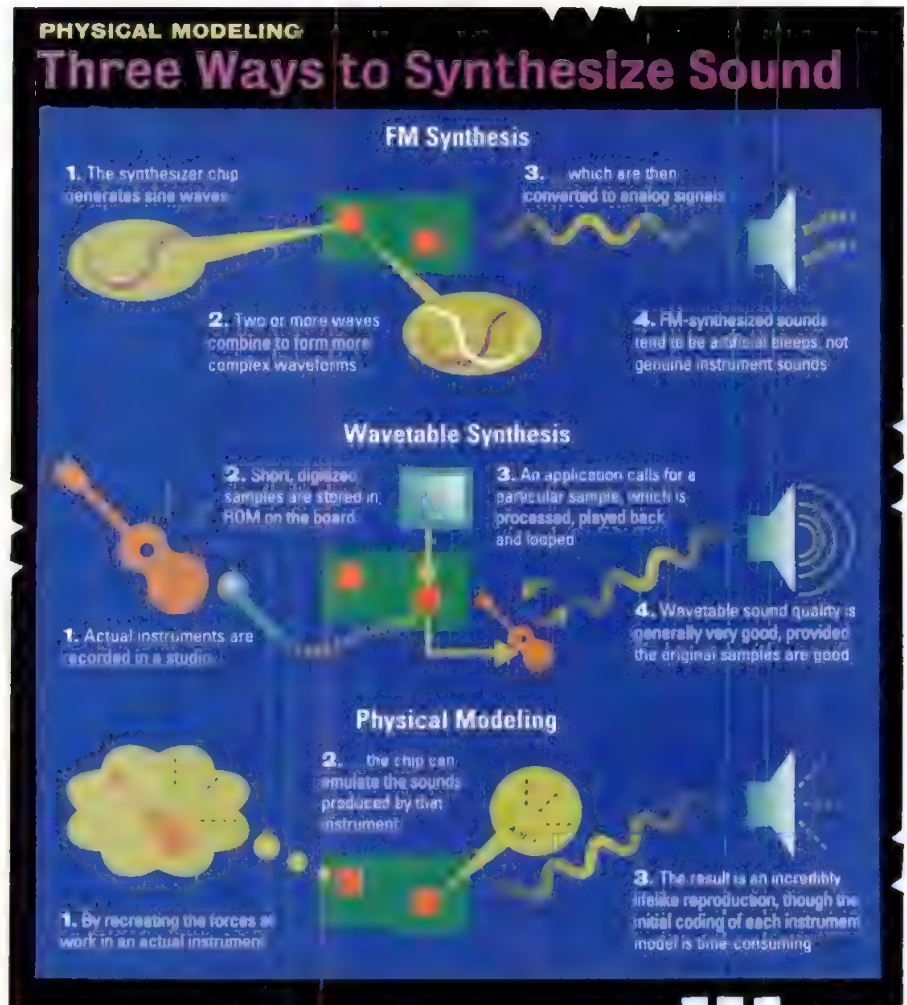
A few USB ports can replace disparate back-panel connectors, including audio connection. More important for PC audio, USB also lets subsystem vendors move audio-signal processing out of the electrically noisy PC box and place the digital-to-analog (D/A) converters in a speaker system, improving audio fidelity, and in some cases obviating the need for a dedicated sound board. USB is appearing on new PCs and audio subsystems with increasing regularity, which should streamline the PC/audio interface.

IEEE 1394 supports speeds of 100 to 400 Mbps, with future implementations to reach 1 to 2 GBps or faster. IEEE 1394 is perfect for connecting PCs to bandwidth hogs such as video camcorders, satellite decoders, and other audio/video gear. It offers USB-like features such as plug and play and hot-swapping, and it allows branching or daisy-chaining topology.

IEEE 1394 has already appeared in digital video cameras and digital VCRs and will trickle down to lower-cost applications. With USB and IEEE 1394, the PC can be treated as a server/controller within a home-entertainment network of peripheral devices.

EVOLVING SYNTHESIS METHODS

Sound boards have grown in complexity from their origins as simple MIDI synthe-



sizers employing FM synthesis, and the majority of boards sold today employ *wavetable synthesis* to generate music. This sample-based synthesis uses short recordings of actual musical instruments and other natural sounds for basis waveforms. Because musical events may last several seconds or longer, considerable memory would be required to store all the data needed for every possible musical event. However, most musical events consist of an attack transient, followed by a steady-state sustain and decay. Therefore, only the transient portion and a small section of the steady-state portion needs to be stored. Sound is rendered by reading out the transient, then setting up a loop through the steady-state section.

The quality of the synthesis you get from a given sound board depends on the quality of the initial recording, the size of the sample table, and the location of the loop points. Short, low-resolution tables produce poor-quality tones. Although a

sound board may claim to have "CD-quality" sound, such boards may feature 8-, 12-, or 14-bit table resolutions, not the 16-bit CD standard.

Recently, *physical-modeling synthesis*, developed by engineers at Stanford University, has gained in popularity. Physical modeling emulates the sound of a vibrating system (such as a musical instrument) by creating an analogous software model. For example, a plucked string vibrates because transverse waves propagate along the length of a string. The vibrations decay as the waves lose energy. A string model might consist of an impulse traveling through a circular delay line (or memory buffer) whose output is connected back to the input through an attenuator and filter. The filtering and attenuation cause the impulse to decay in amplitude and become more sinusoidal in nature simultaneously, just like a vibrating string. The filter, the attenuator, and the length of the buffer-controls pitch provide the

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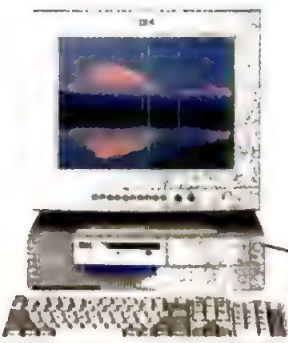
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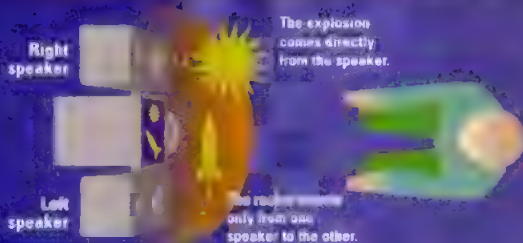


POSITIONAL AUDIO

The Steps Beyond Stereo

Stereo

Traditional stereo creates a limited soundstage that spans the distance between the left and right speakers.



Expanded Stereo

Expanded stereo (also called *spatialization* or *3-D enhancement*) uses algorithms to widen the sound field so that effects and music seem to envelop the listener from many directions.



Positional Audio

Positional audio takes things one step further, by letting developers pinpoint the location of sound effects in space—to the left or right of you, or even above, below, or behind.



correct timbre and decay.

Physical modeling is attractive because it is easily implemented in software, it can theoretically produce consistent results on different machines, and the coded algorithms are quite short; but fast processors are needed to synthesize such sounds in real time. Creative Labs was one of the first sound board vendors to implement physical modeling in an end-user product. In addition to 4MB of traditional wavetable samples, Creative Labs' Sound Blaster AWE64 Gold board has 14 instruments recreated through physical modeling.

FROM DOS TO DIRECTX

Computer-game and edutainment developers have long embraced the DOS environment because it allows ultra-low-level access to multimedia components such as synthesizers on sound boards. DOS developers are able to mix and pan multiple audio .WAV files so that, for example, explosions can blend with engine sounds

instead of interrupting them. Developers merely request the API from the peripheral vendor and use the low-level functions it contains to implement complex audio and video functions.

Windows adds considerable complexity to the DOS environment. The Windows Multimedia API allows access to sound board functionality. However, developers cannot access the peripheral directly—they are limited to whatever access functions Windows provides. For example, the original Multimedia API provides no direct means to mix audio files, so explosions interrupt engine sounds.

Microsoft's DirectX API suite is designed to overcome this problem and promote high-performance multimedia application development in Windows rather than in DOS. The DirectX 5.0 API effectively provides real-time, low-level access to peripherals used specifically in intensive audio/video applications. For example, the DirectSound portion of DirectX pro-

vides functions for mixing audio files and controlling each file's volume, balance, and playback rate within the mix.

DirectX APIs divide multimedia tasks into components, including DirectDraw, DirectSound, DirectSound3D, DirectPlay, DirectInput and DirectSetup. DirectSound provides device-independent access to audio-accelerator hardware, as well as features such as real-time mixing of audio streams and control over effects such as volume and panning. DirectSound also provides low-latency playback so that sounds can be synchronized with other events. A recent innovation called DirectSound3D provides 3-D sound capabilities using only two speakers or a pair of headphones rather than the five speakers (plus subwoofer) required by a typical surround-sound setup.

Increasingly, vendors are providing DirectX drivers in addition to their standard Windows drivers. For example, Creative Labs provides a Sound Blaster DirectX driver that provides access to the fast SRAM on a Sound Blaster board, accelerating audio functionality. If a vendor does not supply a DirectX driver, Microsoft provides an emulated DirectX driver. Although the emulated driver is slower, the developer still retains access to enhanced functionality. DirectX finally gives the developer access to low-level hardware functions and provides a migration path from existing DOS-based games into Windows.

BEYOND STEREO

Since its introduction to the consumer market in the mid-1950s, stereo has defined the essence of audio reproduction. Stereo can convey a traditional *soundstage* in which the sound comes mainly from the front, such as the sound one experiences when attending a concert. But even well-recorded stereo cannot convey the ambiance of acoustical environments in which sound is detected from all around the listener. Stereo's lack of spatiality undermines sonic realism in, for example, a game where aircraft fly overhead from front to back or monsters mutter softly on each side.

To provide larger, more enveloping sound fields, many companies have devised algorithms that modify stereo sounds so that, although they are played over two

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Talking About Sound: A Glossary

AC '97 Intel's recommended standard for PC audio circuitry. The specification reduces noise by partitioning analog and digital components into separate modules.

DirectX This Microsoft Windows API was designed to provide software developers with direct access to low-level functions on PC peripherals. Before DirectX, programmers usually opted for the DOS environment, which was free of the limited multimedia feature set that characterized Windows for many years.

MIDI (Musical Instrument Digital Interface) A communications standard for relaying information about a sound from an application or digital musical instrument to a synthesizer chip. MIDI commands contain all the information a sound board needs to reproduce the desired sound.

General MIDI and **Roland GS** (General

Synthesizer) are two overlapping specifications for defining the standard sets of MIDI sounds that are associated with specific commands.

PC '97 This Microsoft specification includes prescriptions for noise and distortion limits on the PC sound subsystem.

Physical-modeling synthesis. A revolutionary method for generating sound. This technique emulates the impulse patterns of real-world instruments using a software model.

S/PDIF (Sony/Philips Digital Interchange Format) An interface standard that lets users connect sound equipment (such as sound boards and speakers) via a pure digital signal.

3-D sound A blanket term for technologies that alter the way sound is distributed in real-world space. **Spatialization** broad-

ens the soundstage (the area in space where the sound seems to be coming from), making it more dramatic and spacious, and gives the illusion of pushing it beyond the physical location of the speakers. **Positional audio** uses encoded audio streams to position sounds realistically in the space around the listener when the sounds are played back on compatible equipment.

Wavetable synthesis A common method for generating sound electronically on a PC. Output is produced using a table of sound samples—actual recorded sounds—that are digitized and played back as needed. By continuously rereading samples and looping them together at different pitches, highly complex tones can be generated from a minimum of stored data without overtaxing the processor.

speakers, sounds can seem to come from all around. Stereo-expansion algorithms (such as those from SRS Labs and Spatializer Audio Laboratories) enlarge perceived ambiance, and many sound boards and speaker systems contain the circuitry necessary to deliver expanded stereo sound.

Three-D-positioning algorithms take things one step further. They seek to place sounds in particular locations around the listener—to the left or right, above or below—to be congruent with what's happening on-screen. Psychoacoustic cues such as interaural time delays and intensity differences are used to replicate the way sources would sound if they were actually being heard in a 360-degree space.

This processing often uses a *head-related transfer function* (HRTF) to calculate sound heard at the listener's ears relative to the spatial coordinates of the sound's origin. For example, a sound on your left is heard a split second sooner by your left ear than by your right, and your right ear hears the sound at a slightly different pitch because of the way the sound waves travel around your head. Software developers can use delay techniques and phase shifting to recreate this effect and position sound either at a point in space (as if someone is behind you) or moving through space (such as a rocket roaring past). Results differ, but are generally quite good if the listener is seated in the "sweet spot" between the

speakers. In some cases, the surround process must be encoded in the source media itself, though emerging sound boards and speakers will be able to generate such effects in real time.

Companies such as Aureal Semiconductor, QSound Labs, and Spatializer SRS offer a wide variety of 3-D audio plug-in and chip options. Surround programs written for DirectSound will contain compatible positioning information required by the spatial-positioning programs. Without question, surround synthesis is a great improvement over stereo for many applications.

In the consumer-audio market, stereos are being displaced by home-theater systems in which six speakers are typically mandated. Drawing inspiration from commercial movie theaters, home theaters employ 5.1-channel playback in which there are five main speakers (left and right front channels, a center front channel, and left and right rear channels) and a low-frequency effects channel, or subwoofer (the .1). Two competing technologies, Dolby Digital (formerly known as AC-3) and DTS (Digital Theater Surround), employ 5.1-channel processing. Both systems improve on older surround systems such as Dolby Pro Logic, in which channel separation was lacking and the rear channels were monaural.

Dolby Digital turned into a juggernaut

when it was chosen as the audio coding method for DVD as well as Digital TV; DTS support is less visible. As DVD-ROM drives displace CD-ROM drives, PC users will want to play back the 5.1-channel audio tracks on both movie and game titles.

Although 5.1-channel playback improves realism, it presents the practical problem of arraying six loudspeakers around a desktop PC. Thus, a number of surround synthesis companies have developed algorithms specifically to replay multichannel formats such as Dolby Digital over two speakers, creating "virtual" speakers that convey the correct spatial sense. This multichannel virtualization processing is similar to that developed for surround synthesis. Dolby Laboratories grants a "Virtual Dolby" certification for both the Dolby Digital and Pro Logic processes. Some examples of Dolby-certified processes include Aureal Semiconductor's A3D Surround, Spatializer Audio Laboratories' DVS-5.1, QSound Lab's QSurround, and SRS Labs' TruSurround. Although none of these can compare with having five distinct speakers, virtual speakers can provide good sound localization around the PC listener.

AC '97: IMPROVING PC SOUND QUALITY

Home stereos have enjoyed sonic superiority over PCs, but the *Audio Codec '97* specification seeks to challenge that. This com-

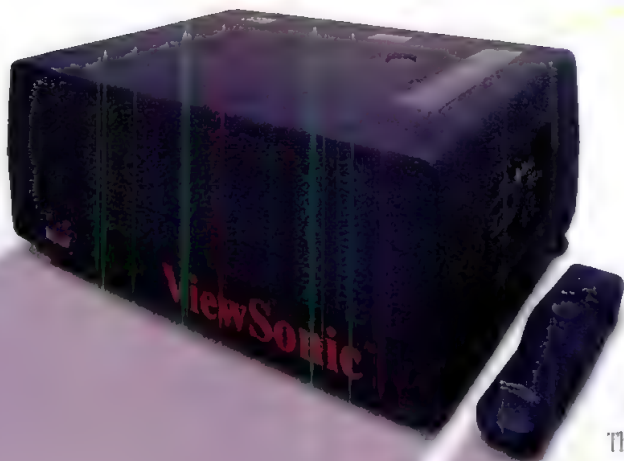
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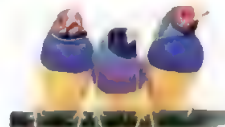
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ponent specification describes a two-chip partitioned architecture that provides high-quality PC audio at an affordable price. AC '97 supports all Windows drivers and bus extensions, and it can be used either on the motherboard or as an add-in board.

With today's ISA systems, integrated hardware is placed on the ISA bus. This means that analog audio circuitry is consolidated with digitally intensive bus interfaces and digital-synthesizer circuits, resulting in audio-signal degradation. In contrast, AC '97 is designed for PCI, USB, and IEEE 1394 and calls for two chips—one primarily analog and the other digital—to segregate vital analog audio sections from other digital sections.

The AC '97 specification defines the baseline functionality of an analog I/O chip and the digital interface of a controller chip. The analog chip is designed to be placed near the audio I/O connectors and away from noisy digital buses. The digital controller/processor chip can be located near the CPU or system bus, or integrated with other core logic chips. Both analog and digital controller chips are connected via digital serial links which are impervious to the electrical noise typical within a PC.

AC '97 provides for multiple analog inputs, four- or six-channel output, USB and IEEE 1394 ports, a headphone jack, and more. The specification allows digital audio to be looped through system memory where it can be processed and output to any internal or external destination. The flexibility of AC '97 allows chip makers to develop a range of compatible chips with different functions. A basic chip set might connect the computer to simple analog I/O. A sophisticated chip set might perform I/O and conversion, as well as digital mixing, filtering, compressing and expanding, reverberation, equalization, and synthesis. Given its PCI-bus performance and higher audio specifications, AC '97 is another hitherto-missing link between computers and quality audio.

EMERGING AUDIO CHIP SETS

These emerging technologies have given birth to a powerful new breed of audio/video processors. Many can either be used on a discrete sound board or serve as a complete "sound board on a chip" and be integrated onto a system's motherboard, lowering overall system cost.

USB: More Sound, Better Sound

PC speaker systems that decode audio data streamed across the PC's Universal Serial Bus are just around the corner. They contain integrated digital-to-analog (D/A) converters that produce output free from the analog noise that plagues today's sound boards, and they help enable advanced features such as multichannel audio.

The PC environment is hostile to clean audio production. The various components in the box generate a lot of electromagnetic interference (EMI), which limits the quality of the signals that even a good sound board can produce. In addition, today's sound boards are limited in the number of audio channels they generate and stream at one time, which means they cannot be used in multichannel surround-sound systems without adding processing power elsewhere (an extra add-in board, for instance).

USB audio, by contrast, is created outside of the PC box. The audio signal remains in the digital domain as it is generated and processed inside the

PC (either by a sound board or a lower-cost audio chip set integrated onto the motherboard) and converted to analog in the speaker cabinet, which allows for signal quality that meets or exceeds that found in home stereo systems. In addition, the setup and bandwidth of the USB architecture allow for the creation of multichannel surround-sound systems, since USB audio allows data processing to be done by the host processor in the PC.

Both Altec Lansing and Philips will have USB speakers by the time you read this. Philips will release its DSS350 (\$199 list), a two-piece digital system that can be configured with an analog subwoofer. Altec's ADA49 (\$199 list) will be a three-piece digital system, and the company also plans a six-cabinet ADA600 (\$599 list) model designed for multichannel Dolby Digital surround sound systems. Of most interest to PC users is Altec's ADA305 system (\$199 list), which will deliver five-channel Dolby Pro Logic surround effects from only two satellites and a subwoofer.—DL

How USB Audio Works

Traditional system

In a traditional PC sound system, all of the audio data is produced inside the PC box, which is an electrically noisy environment hostile to clean audio.



USB system

USB moves the digital-to-analog conversion out of the PC, which enables cleaner audio. Simple audio subsystems could even do without a sound board.



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How MIDI Makes Music

The *Musical Instrument Digital Interface* (MIDI) specification was developed in the early eighties, originally to facilitate the interconnection of synthesizer keyboards. Since then, MIDI has become a standard way for applications to generate music and other sounds through a PC sound board.

MIDI commands communicate events, not actual digital audio samples, using compact binary messages. A MIDI byte contains 8 bits of information (not counting the Start and Stop bits separating successive commands) that tell the sound board everything about the desired sound—including instrument, note, duration, intensity with which the note is played, and more.

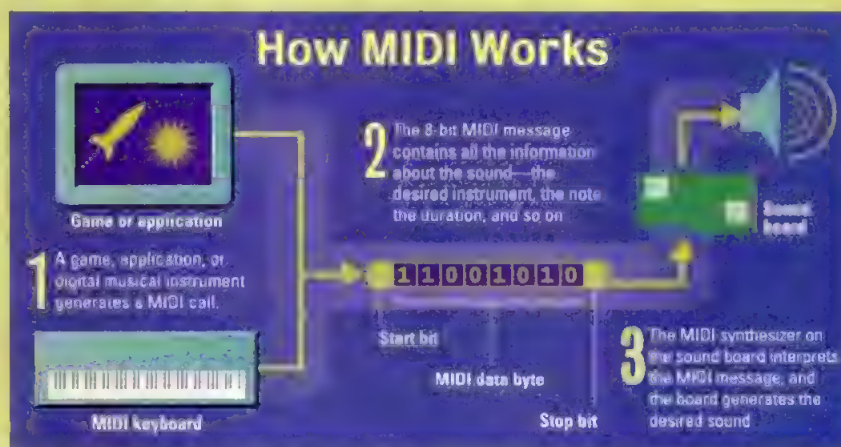
Since a MIDI file contains musical events, not audio waveform data, MIDI files are very small compared to .WAV files. And because MIDI files can be streamed with low overhead and downloaded very quickly, they are attractive in Internet applications. At

the client end, the user must have a MIDI synthesizer installed on the local machine. (Almost all PC sound boards contain MIDI synthesizers to render the data bytes into music.)

The original MIDI specification did not establish which instrument sounds (called *patches*) should be included on a given synthesizer. A song recorded with piano, bass, and drum sounds on one synthesizer could

be played back as glockenspiel, accordion, and flute on another synthesizer—not a good thing.

The *General MIDI* specification set a new standard governing the ordering and naming of sounds in a synthesizer's memory banks. This standard allows a musician or applications developer to specify MIDI addresses and know the music will be synthesized correctly.—*WP*



For example, several companies have developed 5.1-channel audio solutions for the PC environment. Using the Mpact media chip for processing, Chromatic Research has introduced Mpact 3DVD "mediaware" that fully supports 3-D and 2-D graphics as well as DVD. The software-driven single-chip media processor, while simultaneously processing DVD, decodes Dolby Digital into six independent channels and provides SRS surround processing. The Mpact 3DVD mediaware is intended to ensure audio/video synchronization, regardless of other system activity, through more efficient processing and its single-clocked one-chip architecture. The chip also decodes two-channel MPEG-1 layer II and MPEG-2 audio. Leadtek and E4 have already announced multimedia add-in PCI boards that carry this new Mpact technology.

The Cirrus Logic/Crystal Semiconductor CS4610 is an example of a contemporary PCI audio processor. The programmable 300-MIPS DSP engine, clocked at 100 MHz, supports up to 96 streams of digital

audio, up to 20 streams of 3-D audio, up to 64 voices of synthesized sound, and decoding of 5.1-channel DVD audio. Compatible functions include Microsoft DirectSound3D, Aureal 3D, wavetable synthesis with effects, Dolby Digital (either six discrete channels or two-channel Dolby Virtual), and MPEG-1 and MPEG-2 layers I and II audio. The chip also provides complete General MIDI compliance with reverb and chorus processing, and future support for Microsoft DirectMusic and downloadable samples (DLSS).

S3's SonicVibes chip, meanwhile, is a PCI-based audio processor that provides all the audio synthesis and conversion functions normally found on a sound board, as well as DDMA support for legacy compatibility, SRS stereo expansion, and 3-D-surround simulation. The SonicVibes chip also supports Microsoft's DirectSound and DirectMusic APIs.

WHAT IT MEANS FOR USERS

With the many technology options, PC audio is poised for incredible growth.

The sound of many audio sources, from Internet streaming audio to DVD—processed with powerful audio accelerators, running through fast internal and external buses, and replayed over real and virtual surrounding speakers—should be spectacular.

Application developers will certainly push this technology to its limit. We will see aggressive audio applications, such as Internet-based, multiplayer gaming in which sound effects, 3-D streaming audio, synthesized music, and ambient CD-quality sound tracks run simultaneously. For business users, the new processing power and better audio fidelity should improve applications such as videoconferencing and voice mail, while the lower-priced motherboard and PCI solutions will help drop the price of PC systems.

Low-fidelity PC sound quality will eventually become as extinct as monochrome green screens, 5.25-inch floppy disks, and daisy wheel printers, and the gray area between home computing and home entertainment will blur into oblivion.

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Sound Boards and Speakers

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To improve your PC's sound today, upgrade to a better sound board and speakers.

It's common these days to dismiss sound boards as an endangered species. With software MIDI synthesizers now a reality and audio circuitry rapidly migrating to the motherboard, you could easily predict the demise of traditional add-in sound hardware.

But the sound board is far from dead. The number of cards on the market has certainly declined, but those that have survived have adapted to desktops dominated by MMX processors, the PCI bus, and Microsoft's DirectX APIs. To survey the current state of the art, we

tested four boards aimed at mainstream business and home users from four of the largest remaining sound card vendors: Creative Labs (which dominates the market), Diamond Multimedia (which is coming on strong), Ensoniq (first to market with a PCI audio solution), and Turtle Beach Systems (known for higher-end boards for musicians and hobbyists).

These four boards are entry-level or midlevel products that sell for \$85 to \$200 (street). They offer features such as DirectX acceleration, 3-D sound enhancement, S/PDIF digital outputs, integrated software/hardware synthesizers, and the ability to download new MIDI sounds into on-board RAM. Two are traditional ISA boards, and two are newer PCI boards designed to minimize system overhead when running titles that combine multichannel sound tracks with CPU-busting 3-D animation and video.

BOOMING SPEAKERS

Compared with the dwindling number of players in the sound board industry, the desktop-speaker market is exploding. Traditional

makers of PC speakers (such as Altec Lansing, Labtec, and Yamaha) have new competition from home-stereo-speaker players (such as Acoustic Research, Bose, and Cambridge SoundWorks), which see great opportunity in the growing demand for quality PC audio.

In this section, we review models from the ten largest vendors in the PC speaker arena. The entries cover the field from \$60 two-piece units to \$200 three-piece systems. For those who are truly passionate about their PC sound, we

also try out five sets of loudspeakers that deliver audiophile-quality output at prices ranging from \$250 to \$600.

Although the PC-speaker landscape is about to change with the appearance of digital speakers that stream audio data across the Universal Serial Bus or that offer 5.1 surround-sound functionality for DVD audio, none of these innovations has yet made much of an impact. The overwhelming majority of speakers sold today are still two-channel models that plug into a sound board's analog output and cost well under \$200. Many do provide features like expanded stereo sound, the ability to mix multiple inputs, and adjustable crossover frequencies that make it easier to tweak subwoofer characteristics. But the packaging and performance of the familiar desktop-speaker system is still much the same as it was five years ago.

So here we present a snapshot of desktop-sound technology at the cusp of the new year. There's a sound board and set of speakers here for almost every need and budget.—Don Labriola



It's All in the Cards

The lower-priced solutions reviewed here are impressive values, but for top-quality MIDI synthesis or other professional functions, opt for the more expensive offerings. The Diamond Multimedia and Ensoniq boards are PCI offerings targeted at gamers. The ISA-based Creative Labs and Turtle Beach products are likely to satisfy multimedia developers.

CREATIVE LABS SOUND BLASTER AWE64 GOLD



The Creative Labs Sound Blaster AWE64 Gold (\$200 street) offers something for nearly everybody. Loaded with hardware accessories and an over-the-top selection of software, the AWE64 Gold is one of the most comprehensive

sound board packages we've seen.

In addition to Creative Labs' standard assortment of DOS and Windows Sound Blaster utilities, the board includes Creative's WebPhone Internet videophone software, a microphone and stand, a MIDI game port cable, an audio cable with gold-plated RCA plugs, Internet application software from Microsoft and Progressive Audio, a library of music and sound clips, and several popular DirectX games.

The AWE64 Gold is a high-quality



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Editors' Choice

- Sound boards: Creative Labs Sound Blaster AWE64 Gold
- Speakers: Altec Lansing ACS48, Cambridge SoundWorks



Though the PC audio landscape is in flux, users looking to buy right now have some fine choices. Among the

four sound boards we tested, our Editors' Choice goes to the Creative Labs Sound Blaster AWE64 Gold (\$200 street). It is a robust, well-behaved ISA board, loaded with features for both gamers and recording hobbyists. An honorable mention goes to Diamond Multimedia's Monster Sound (\$150 street). This PCI card is ideal for Windows 95 gamers who play a lot of resource-hungry DirectX titles.

When the smoke cleared in our speaker test room, we

wound up with two favorites from the 11 mainstream models we tested that deserve Editors' Choice awards. For the most accurate, full-range sound, we chose the smooth, natural-sounding SoundWorks (\$200 street) from Cambridge SoundWorks. But if you want to rock and roll or annoy the neighbors with game effects, the wall-shaking Altec Lansing ACS48 (\$150 street) is tough to beat.

Two sets merit honorable mention. The two-piece Bose MediaMate (\$150 street) delivered sound just as airy and natural as the SoundWorks, though with less bass than its three-piece competitor. Labtec's LCS-1022 (\$45 street) isn't in a class with these other systems, but if your budget is tight, the LCS-1022 produces sound that's easy to live with, for a fraction of the price of the more expensive systems.

multilayer board with a central ground-plane layer designed to reduce analog noise and an S/PDIF digital-audio output jack mounted on a second back-panel plate.

As with earlier boards in the AWE line, the AWE64 Gold incorporates E-mu Systems' 32-voice EMU-8000 wavetable synthesizer chip. The chip provides reverb and chorus capabilities, and its default sample set supports Roland's GS standard, which adds hundreds of sounds to the 128 standard General MIDI instruments. The board can also provide Creative's WaveSynth/WG software synthesizer, which generates up to 32 additional voices by manipulating mathematical models of musical instruments.

The AWE64 Gold ships with 4MB of Sample RAM, which can be expanded to 28MB, for storing new MIDI sounds. You can either create the sounds manually from .WAV files or purchase them from Creative's proprietary SoundFonts format.

The board also supports the E-mu 3D Positional Audio technology. When used with preencoded source material, this spatialization feature positions sounds in a 360-degree sound field using Creative's proprietary 3-D stereo enhancement technology.

Installing the AWE64 under Windows 95 was a snap, thanks to excellent documentation and a mature Plug and Play implementation. The board also offers robust DOS capabilities and is compatible

with Creative's ubiquitous Sound Blaster and Sound Blaster 16 standards.

The AWE64's MIDI synthesizers provide a satisfactory gaming experience. Professional multimedia composers and MIDI may want to look to a higher-end solution, such as the \$1,195 Roland Sound Canvas, for content creation, as output often sounded shrill and synthetic. The relative loudness of each instrument also differed from the Sound Canvas's de facto standard, changing the mix of some MIDI test files in unpredictable ways.

Since the AWE64 Gold lacks hardware DirectX acceleration, its MIDI output is unexceptional. But it covers nearly every other base, making it one of the safest bets on the market for all but the most demanding musical applications. (Creative Labs Inc., Milpitas, CA; 800-998-1000; www.soundblaster.com. *Circle 441 on reader service card.*)

DIAMOND MULTIMEDIA MONSTER SOUND

The **Diamond Multimedia Monster Sound** (\$150 street) is a new-generation Windows 95 sound accelerator that uses the PCI bus and DirectX sound.

Much of its power is provided by an on-board DSP (digital signal processor) that performs operations like digital mixing, sample-rate conversion, and joystick polling. These reduce system overhead and accelerate Microsoft's DirectSound, Direct-

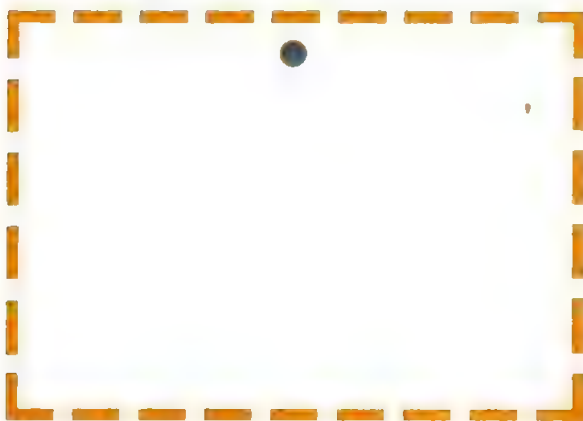
Sound 3D, and DirectInput APIs. They also accelerate Aureal Semiconductor's A3D Interactive algorithm, which applies 3-D positional sound and Doppler-like pitch-shifting effects to properly encoded input. The board also conforms to Microsoft's PC 97 recommendation, which defines limits for noise and distortion.

The Monster Sound provides a second line-out jack for immersive four-speaker sound, and its bundled utilities let you tune 3-D output for headphone, two-speaker, or four-speaker configurations. It also includes a DirectInput-compliant accelerated joystick port and a modem connector for speakerphone and video-phone audio.

Installing the Monster Sound took only a few minutes, thanks to its superior PCI plug-and-play implementation. The only printed documentation consists of a Start-up pamphlet, but there is extensive online help. In addition to the standard complement of sound board mixer/player utilities, the Monster Sound's competitive software bundle includes a MIDI sequencer and sound-editing applications, plus several popular game titles that take advantage of the board's 3-D sound capabilities.

The Monster Sound's 32-voice Ad-MOS AdWave32 synthesizer is arguably the best in this roundup, although you would not want it for serious General MIDI music applications. It lacks patch-

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PERFORMANCE TESTS

Sound Boards



All four of the sound boards we tested showed frequency response that is good enough for typical business and game applications. Two of the boards are robust enough for recording hobbyists and multimedia developers.

What the Numbers Mean

Frequency response indicates how well a sound board reproduces sound ranging from deep bass to high treble. Ideally, a board should handle all frequencies from 20 Hz to 20,000 Hz (the range of human hearing) uniformly. Such a frequency curve, when plotted, would yield a straight line at 0 relative decibels (dBr), give or take 1 dB. A drop-off of 2 dB can be expected above 18,000 Hz because of the treble cutoff filter in most boards. Less fluctuation along the curve equals better sound reproduction. We tested frequency response in both the digital-to-analog (D/A) and analog-to-digital (A/D) domains.

Good D/A frequency response is important for sound repro-

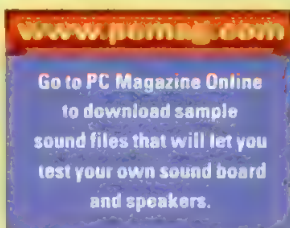
duction, such as the generation of sound and music in applications and games. In this roundup, the Turtle Beach Malibu Surround 64 showed the best D/A frequency response, with a relatively flat signal from 31 Hz to 18,000 Hz. The Creative Labs Sound Blaster AWE64 Gold (our Editors' Choice in this review) also showed a fairly robust range, delivering good response from 70 Hz to 17,000 Hz. The Diamond Multimedia Monster Sound showed good bass response (as low as 40 Hz), but high treble began to roll off at around 15,000 Hz.

A/D frequency response is of interest to multimedia developers and musicians who plan to use boards for recording. Here, the Creative Labs entry outshone the others, with a clean signal from 32 Hz to almost 17,000 Hz. Turtle Beach's Surround 64 was strong at the low end (kicking in at 50 Hz), but the signal began to drop off at only 13,000 Hz at the high end. Predictably, the low-cost Ensoniq offering delivered just fair A/D frequency response.

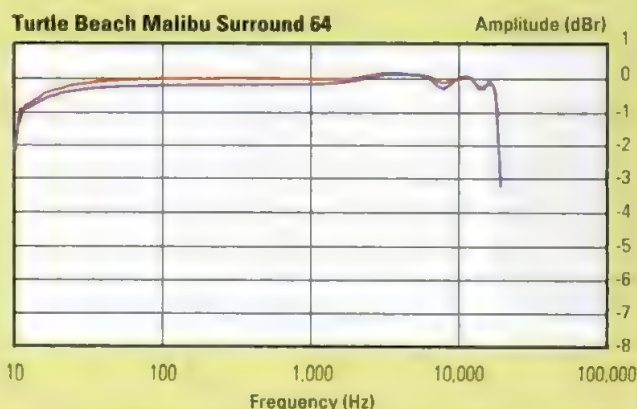
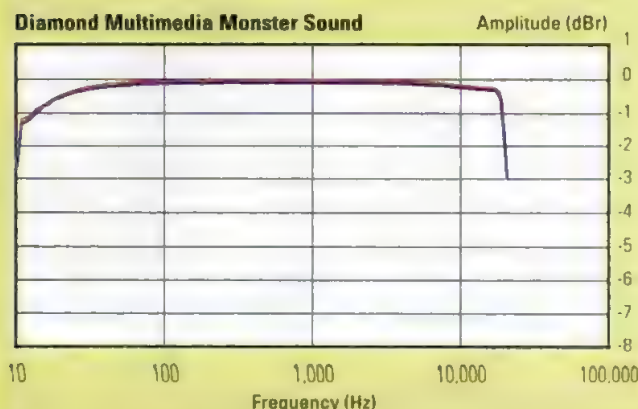
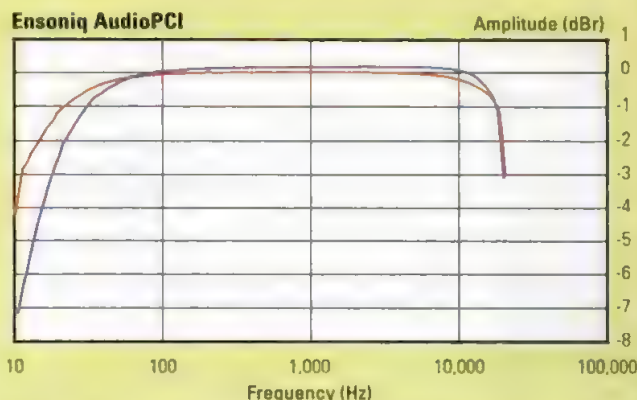
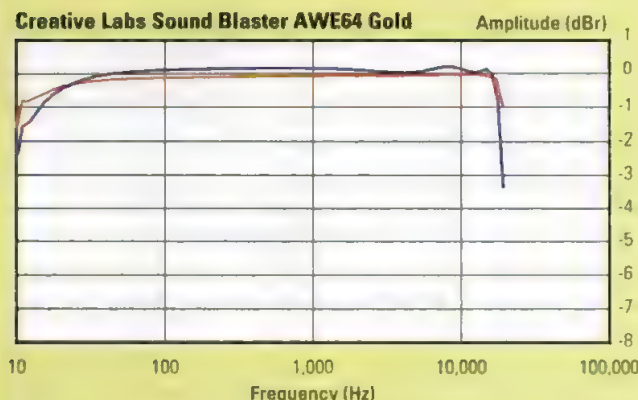
How We Tested

The A/D and D/A Frequency Response tests measure a board's ability to reproduce sound from 20 Hz to 20,000 Hz.

We used the Audio Precision System One (APSO) to generate and analyze test signals. All boards were tested in 16-bit stereo mode at 44.1-kHz sampling rate.



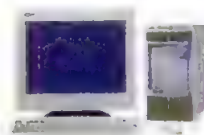
16-BIT FREQUENCY RESPONSE





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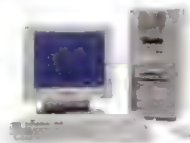
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SUMMARY OF FEATURES

Sound Boards



■ YES ■ NO	Creative Labs Sound Blaster AWE64 Gold	Diamond Multimedia Monster Sound	Ensoniq AudioPCI	Turtle Beach Malibu Surround 64
Street price	\$200	\$150	\$85	\$80
Bus architecture	ISA	PCI	PCI	ISA
Supports Windows 95/NT 4.0/3.x	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
Supports DOS	■	■	■	■
Audio chip set	Creative V 32D	Analog Devices 1843	AKM-4531	Crystal Semiconductor 4237
Sound Blaster Pro-compatible	■	■	■	■
DirectSound support	DirectSound 5.0	DirectSound 5.0	DirectSound 5.0, 3D	DirectSound 3.x
Hardware/software wavetable synthesizer	■ ■	■ ■	■ ■	■ ■
ROM for on-board samples	4MB	16MB	None	4MB
Maximum parts (simultaneous timbres)	16	15	32	16
Maximum voices (simultaneous tones)	64	32	32	64
Number of MIDI instruments/drum kits	503 / 24	240 / 80	128 / 10	128 / 64
Claimed signal-to-noise ratio	>90 dB	>92 dB	>90 dB	>92 dB
Claimed 16-bit sampling range	5-44.1 kHz	8-48 kHz	5-48 kHz	5-48 kHz
DSP model	E-mu EMU8000	Analog Devices 2181	Ensoniq AudioPCI ES1370	Crystal DSP (optional)
Primary DSP function	Real-time effects, wavetable synthesis	A3D positional audio	PCI-bus control, real-time effects, wavetable synthesis	Dolby Digital audio, wavetable synthesis
MIDI output effects	Reverb, chorus, delay, expanded stereo, E-mu's 3-D positional audio	Pan, time-varying filter, vibrato	Chorus, reverb, 3-D positional audio	Chorus, reverb, SRS expanded stereo
Microphone-in/Line-in/Line-out	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
MIDI or joystick/Internal CD audio	■ ■	■ ■	■ ■	■ ■
Mixer rack	Creative Mixer	Willow Pond	Voyetra AudioStation2	Voyetra AudioStation2
.WAV recorder	Creative Sound LE	Willow Pond	Voyetra AudioView	Voyetra AudioView
MIDI sequencer	Voyetra MIDI Orchestrator Plus	Willow Pond	Voyetra MusicWrite	Voyetra MIDI Orchestrator Plus
Sound editor	Creative Wave Studio	Willow Pond	Voyetra AudioView	Voyetra AudioView
Wavetable sample editor	Vienna SoundFont Studio 2.1	None	None	None
Warranty	1 year	3 years	3 years	1 year
Toll-free technical support	■	■	■	■
Live technical-support hours (eastern time)	8:00 A.M.-10:00 P.M., 7 days	8:00 A.M.-10:00 P.M. M-F, 11:00-7:00 Sat.	9:00-5:30 M-F	9:00-5:00 M-F
Web address	www.soundblaster.com	www.diamondmm.com	www.ensoniq.com	www.tbeach.com

editing and wavetable-downloading capabilities, and like the audio section, provides no reverb or chorus effects. Brass and percussion instruments sound fine; but others such as cymbals, guitars, and pianos aren't as realistic. Nonetheless, the relative loudness of each instrument is close to that of a standard Sound Canvas, and the quality of the MIDI output is adequate for most games.

Like most PCI sound boards, the Monster Sound is unable to provide Sound Blaster support under Real Mode DOS because of differences between the board's PCI bus and Sound Blaster's native ISA. Diamond tries to address this problem with DOS emulation software that can run many well-behaved Sound Blaster titles under Windows, and by supplying a special cable to connect the board to a second DOS-friendly ISA sound board. Neither of these is a particularly robust solution.

The Monster Sound is foremost a Windows 95 game board—and a power-

ful one. Despite its limited synthesizer and DOS constraints, the Monster Sound is a terrific board for resource-hungry DirectX games. (Diamond Multimedia Inc., San Jose, CA; 408-325-7000; www.diamondmm.com. *Circle 442 on reader service card.*)

ENSONIQ AUDIOPCI

Selling for a mere \$80 on the street, the Ensoniq AudioPCI is a basic piece of sound hardware. It does not contain a synthesizer chip, but it sacrifices only a little in the way of functionality because it uses the host system's CPU and main memory to implement its most resource-hungry features. When installed on a fast MMX PC, it can be a great way to get superior sound at a bargain-basement price.

Although the AudioPCI ships with only a few basic sound utilities, it supports a comprehensive selection of sound standards—including DirectSound, DirectSound 3D, DLS/DirectMusic and AC '97.

It can position up to 128 audio streams in three-dimensional space, and it offers a proprietary 3-D spatialization algorithm that works with unencoded source material. Our early run evaluation unit didn't include a DLS-compliant patch editor/downloader, but Ensoniq expects to have added one by the time you read this.

Even more impressive is this PCI board's ability to run in Real-Mode DOS, a feature that's usually impossible without access to Sound Blaster resources associated with the ISA bus. The key is the AudioPCI's on-board ES1370 controller chip, which emulates the ISA environment and also provides DirectX acceleration and backward compatibility with Ensoniq's older line of OTTO synthesizers.

To reduce costs, the AudioPCI uses the host CPU and RAM to perform the functions of a MIDI wavetable synthesizer. It also generates Sound Blaster and Roland MT-32 FM MIDI output and reverb, chorus, and 3-D sound effects. A

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AVM Apex: Watch This Space

Tiny AVM Technology is not a major player in the multimedia industry, but its AVM Apex sound board could be one of the most ambitious cards to hit the market this year, so we decided to take a look.

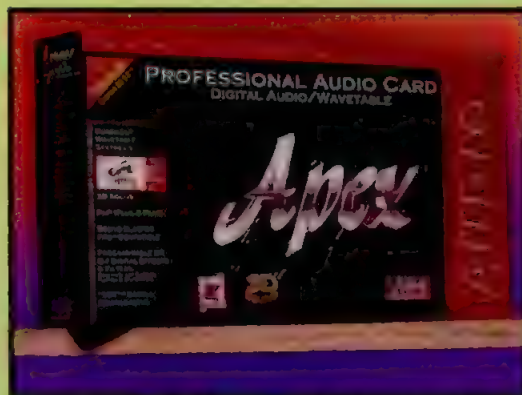
The Apex (\$280 street) provides comprehensive standard features, including 3-D sound, a 20-bit DAC, DirectX support, a robust software bundle, and sample downloading capabilities. It also supports exotic functions like variable sampling rates, which let you micro-adjust audio record and playback speeds without the distortion caused by conventional techniques.

The heart of the board is an advanced Kurzweil MA-1 synthesizer

chip with a dedicated 24-bit effects processor and an on-board Motorola 68030 CPU, which AVM claims dramatically lowers system overhead.

During hands-on evaluation, the Apex was a bit less impressive than we expected, producing slightly synthetic-sounding MIDI output. We were disappointed to find that managing the board's effects processing and sample downloading requires writing low-level MIDI instructions.

AVM hopes to solve these problems with patch-editing and effects-management utilities that should be shipping by the time you read this.



Once this occurs, the Apex could become the pioneering product it deserves to be.—*DL*
(AVM Technology Inc., Sandy, UT; 800-880-0041; www.avmtechnology.com. Circle 457 on reader service card.)

control-panel utility lets you load 2MB, 4MB, or 8MB wavetables into system RAM, and the board's default 4MB table includes General MIDI instrument sets.

On our Pentium/133 test system, the AudioPCI produced uneven MIDI output. The board sounded much like our Sound Canvas reference module when it played some of our test files, but in other cases it was way off. Complex sounds like pianos and brass sounded thin and synthetic, and percussion instruments often played back too loud. Nonetheless, the AudioPCI still sounded better than either the Turtle Beach or Creative Labs boards and would probably produce more realistic approximations of instruments on an MMX PC.

If you have a slower computer and play challenging games that combine 3-D animation, video, and complex MIDI scores, the AudioPCI may not provide the MIDI performance you need. But most other users ought to be impressed by its remarkable combination of low price and sophisticated features. (Ensoniq Inc., Malvern, PA; 800-776-8637; www.ensoniq.com. Circle 443 on reader service card.)

TURTLE BEACH MALIBU SURROUND 64

Another low-priced board is the Turtle Beach Malibu Surround 64 (\$80 street). Unlike the AudioPCI, the Malibu doesn't offload CPU-intensive tasks onto the host processor, and it offers features like 64-

voice hardware/software MIDI synthesis and S/PDIF digital-audio output. It's not in a class with "everything but the kitchen sink" boards like the AWE64 Gold, but for the price, it's hard to beat.

The Malibu is equipped with both a General MIDI synthesizer chip from Kurzweil (a well-known name in MIDI keyboards) and Rockwell Semiconductor Systems' WaveStream software synthesizer, each of which can play up to 32 voices. No patch-editing or sampling capabilities are supported, and the board lacks a DSP chip. The software synthesis provides reverb and chorus.

Since few MIDI files require 64 voices, the final production version of the Malibu will include a Voyetra Synth Layering (VSL) utility that will let users configure the two synthesizers to play in unison. Our test unit only let us toggle VSL layering on or off, but that was enough to reveal that the feature usually makes a dramatic difference. Unfortunately, the effect wasn't always an improvement, and it sometimes upset the delicate instrument mix of our General MIDI test files.

The Malibu's audio section supports the DirectSound and Windows Sound System APIs and includes a hardware implementation of SRS Laboratories' 3-D-spatialization algorithm. It provides full-duplex analog audio but generates digital output only at 44.1 kHz, making a conver-

sion necessary to dump data directly to a 48-kHz DAT tape. The Malibu has a connector for an optional PCI-bus Audio Accelerator board (due early in 1998), which will provide DirectSound acceleration and two added stereo analog outputs for multispeaker surround effects.

Given its price, the Malibu ships with a surprisingly generous software bundle that includes Voyetra's Windows 95/DOS sound board applet suite, the MIDI Orchestrator Plus sequencer program, and the AudioView sound editor.

The board's weakest link is its MIDI output, which was the worst in this survey. The hardware was merely acceptable, often producing slightly synthetic sounding output. Things got worse when we added the software synthesis, which sounded nothing like our reference Sound Canvas. Many parts sounded strangled and artificial, and the board's outrageously loud percussion often drowned out other instruments.

But even if the Malibu may not be the right board for serious MIDI composition or recording applications, it's still a good buy. Despite its flaws, you'll have a hard time finding a more sophisticated game-player's board—especially one with a hardware synthesizer—at this price.—*DL*
(Turtle Beach Systems, Yonkers, NY; 800-233-9377; www.tbeach.com. Circle 444 on reader service card.)

Big Sound for Every Budget

Whether you're videoconferencing, playing a game, or just working with music in the background, the quality of your PC's speakers plays a significant role in your computing experience. And that role is growing ever more important as multimedia makes its way into even the most austere of business applications.

The PC speaker market is booming: There are nearly 100 vendors selling branded speakers in stores and via mail order, and most vendors offer several models. So for this roundup, we tested the most popular sets from the nine largest PC speaker vendors by market share. We present 11 contenders that aim to make your PC's soundscape richer and more satisfying.

ACOUSTIC RESEARCH

At \$150 (street), the **Acoustic Research AR-2103** is one of the pricier products in the roundup. But it's also one of the least impressive.

Each of its 13-inch-high satellites contains a 3-inch midrange driver and 5-watt amp, and each is topped with a 1-inch polycarbonate tweeter mounted on a tilting hinge. All controls and connections are located on the subwoofer, which is designed to sit beneath your PC's monitor. The controls include microphone and headphone jacks as well as a power switch, a mute button, a large master-volume knob, bass and treble knobs, and

left/right balance controls.

We found the system's tabletop design, with its bulky subwoofer and oversize satellites, to be cumbersome. The AR-2103's low-end is unexceptional, most likely because of a 15-watt bass amp that's too small for the subwoofer's large cabinet and dual 4-inch drivers. The midrange is also colored and the overall sound is dull and muddy. (Acoustic Research, Benicia, CA; 707-748-5167; www.acoustic-research.com. *Circle 446 on reader service card.*)

ADVENT

Despite its relatively low \$130 street price, the **Advent Powered Partners AV190** produces sound almost in a class with that of the Cambridge SoundWorks set, which we selected as an Editors' Choice. The Advent system doesn't quite match the SoundWorks' exquisite upper registers, but it does provide a tight, punchy bass that never comes close to booming.

Like the SoundWorks, the AV190's small, pyramidal satellites and waffle-iron-shaped bass module reach only moderate volume levels. This problem is most likely due to underpowered amplifiers that struggle to power the system's relatively large drivers. Each satellite pairs a 3-inch neodymium cone with a puny 2-watt amp, and the downward-firing 5.25-inch long-throw woofer is driven by only 17 watts. Nonetheless, the AV190's high-end is reasonably exten-

sive, and its overall sound from midbass on up is fairly smooth and spacious. The SoundWorks and the Bose MediaMate may offer greater detail and more extensive high ends, but if you're interested in reasonably accurate, full-range sound on a budget, the AV190 is worth a listen. (Advent, a division of Recoton Audio Co., Lincolnshire, IL; 800-323-1566; www.adventaudio.com. *Circle 447 on reader service card.*)

ALTEC LANSING



One listen and you'll know that the **Altec Lansing ACS48** (\$150 street) is targeted at gamers. More of a Mustang than a Mercedes, this system delivers room-filling sound that's loud, spacious, and dominated by a deep, powerful low-end. Each satellite is driven by a hefty 20-watt amplifier, and the oversize subwoofer boasts a 6-inch driver, 40 watts of power, and a massive wooden cabinet. Power and master volume controls are combined in a pair of electronic buttons flush-mounted on top of one of the satellites, and the bass module provides a bass balance control and input jack for a second audio input.

The ACS48's smooth midrange and high end rival those of the SoundWorks and the MediaMate, and despite a slight tendency toward boominess, its subwoofer produced the highest output levels of any speaker in the roundup. The ACS48 may not be an audiophile's dream, but it's one of the best game players' speakers on the market at any price.



Left to right: Yamaha System 25, Labtec LCS-1022, Panasonic EAB-MPC250, Altec Lansing ACS48, Advent Powered Partners AV190.



Microsoft
Because the dates on
are



From: New Microsoft Project 98

Date: Wednesday, 4:45 p.m.

To: Planning Committee

Re: One more little thing...

Your plan is perfect. You're in total control. Then all these...things...start happening. That's why the new Microsoft® Project 98 was built with a start-to-finish obsession about details. About scheduling. Staffing. Costs. The drill-down details that let you know what's happening and what's going to happen to your plan, your budget, and your due date. That's a complex job: Microsoft Project 98 makes it easy. You can go from an overview to the smallest detail in a couple of clicks, planning and tracking work on a daily, weekly, or monthly basis. It's integrated with Microsoft Office 97 and the Internet, so your documentation and communications are right there, from the kickoff memo to urgent e-mails. So while you've still got the time, check out the details at www.microsoft.com/project/.

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High-End Speakers: Big Sound for Big Budgets

Traditional loudspeaker vendors for home stereos have targeted the PC market as the next hot growth area, and their expertise in speaker design means you can now bring a virtual concert hall right to your desk. These high-end systems aren't inexpensive by PC standards, but compared with what audiophiles are used to paying for stereo equipment, these speakers are reasonably priced and do an excellent job.. Although they are clearly overkill for business audio, anyone interested in first-rate PC sound for gaming or listening to music might want to go with one of these.

For this mini-roundup, we auditioned five high-end multimedia systems, with prices ranging from \$219 to \$700. None will disappoint, and a couple will thrill. Each permits simultaneous connection of two stereo sources, so you can connect your sound card as well as an external audio source such as a CD player.

Stereophile Test CD2, PolyGram's Mozart's Piano Concerto No. 21 in C Major, a London release of the Verdi *Requiem*, Proprius's CD set *Jazz at the Pawnshop*, and PolyGram's Classical Repertoire Demonstration Disc.

In most cases, we had to move the satellite speakers around on the desktop to get a deep, wide soundstage without creating an acoustic "hole" in the middle. To improve bass response, we repositioned the subwoofers so that they could reflect sound off an additional surface besides the floor. In general, the best musical balance between on-desk and under-desk speakers is obtained by adjusting the low-frequency output just to the point at which you can no longer hear it. Fortunately, all of the speakers were magnetically shielded, so mounting them next to the monitor didn't distort the image.

The **Bose AcoustiMass Multimedia Speaker System** (\$700 street) consists of

The Verdi *Requiem* had a clarity and spaciousness that allowed picking out different sections of the chorus with ease: the voices did not seem to come from the speakers at all. Brass instruments blended beautifully. To nitpick, a separate volume control for the subwoofer would have been nice, but we found no need for it in our application. This is clearly one of the best PC speaker systems available. (Bose Corp., Framingham, MA; 800-444-2673; www.bose.com. Circle 449 on reader service card.)

The **Boston Acoustics MicroMedia** system (\$219 list) lets you mount its desktop volume control conveniently under one of its pedestal-mounted satellites. It has an additional volume control in the subwoofer, which automatically shuts off after a sufficiently long period of silence. The soundstage had sufficient depth and width during our tests, and frequency response was



Left to right: Boston Acoustics MicroMedia, Bose AcoustiMass, Boston's MediaTheater, Cambridge SoundWorks MicroWorks, Yamaha System 45.

To test the speakers, we listened to a variety of classical and jazz CDs and used several technical measurements in addition to our own ears. Even a slight difference in sound levels subconsciously favors louder-sounding units, so we used a sound-level meter and a band of frequency-neutral "pink noise" to adjust each system to produce the same volume. For our tests, we used selections from the

two small cubes and a large subwoofer unit that contains volume, bass, and treble controls. The dispersion of the cubes was so good that we could even place them at the extreme corners of the desk without disturbing the solidity of the sonic image. Piano tone was excellent—sharp and clear with no hint of stridency—and the jazz group was clear and musical, with instruments well-defined and easy localized.

smooth and uncolored, though the satellites exhibited a mildly constrained quality on loud orchestra-plus-chorus passages. Jazz reproduction was good but not vibrant. Solo piano tone was very good. If you want fine sound but can't justify a \$700 expense, the MicroMedia should make your short list.

Moving up the price scale is the **Boston Acoustics MediaTheater** system (\$349 list), which comes equipped with

a Dolby Pro Logic decoder and a Virtual Dolby Surround processor, designed to create the effect of full five-channel home-theater sound from its two satellites and subwoofer. Volume, surround, and subwoofer are independently adjustable from each of the cubes, and a convenient noise signal rotates repeatedly from left, center, right, and surround to permit adjustment of the speakers' sound outputs.

The satellites produced a distinctly more open sound than their MicroMedia siblings, and the organ bass on the bundled Surround Test I CD was literally room-shaking—it actually blew out a lighted match held up to the port of the subwoofer! We found the five-channel reproduction better suited to a home theater than a PC desktop, however.

On our test selections, the voices on the *Requiem* were clear and unstrained, the soundstage was very wide and deep, and the bass was again exciting. Jazz was smooth and musical, and the solo passages of the Mozart piano concerto were superb. If you're putting together a PC-based home theater system, the MediaTheater is the ticket. (Boston Acoustics, Peabody, MA; 978-538-5000; www.bostonacoustics.com. Circle 455 on reader service card.)

The **Cambridge SoundWorks MicroWorks** (\$349 direct), the top-of-the-line accompaniment to the PC Works and SoundWorks reviewed in the main story, sports an under-desk woofer/amplifier that is slightly larger than most; this translates into a larger soundstage. The satellite cubes are equipped with slightly tilted brackets that keep the highs targeted above your paperwork and a Velcro-mounted volume control adjusts their levels. There's also a set-and-forget volume control on the bass module.

On our listening tests, we found the frequency range exceptionally smooth, with no audible distortion on any of the selections. The soundstage was wide and deep, the jazz clarinet had a mellow, woody sound, and the vibes were excellent. The piano in the Mozart concerto had the correct ring, and the

bass drum in the *Dies Irae* section of the *Requiem* was dead on target. These rate just a hair behind the Bose AcoustiMass, at half the price. (Cambridge SoundWorks, Newton, MA; 800-367-4434; www.hifi.com. Circle 441 on reader service card.)

The **Yamaha System 45** (\$250) has separate volume, tone, and power supplies for each of its tall 10-inch desktop units; on the under-desk subwoofer, it has the same controls plus a switchable high-cut filter. The system produced a good-size soundstage with wide frequency response and no distortion. Piano notes were clear and musical, and on the *Requiem*, orchestra and chorus showed no strain even at levels exceeding 100 dB SPL on the meter. Our *Jazz at the Pawnshop* selection also sounded very good, providing an open-room feel and fine instrumental tone. A little less refined than the MicroWorks, the System 45 goes for a bigger sound that might be more desirable to gamers. (Yamaha Corp. of America, Buena Park, CA; 714-

For the best sound, budget be damned, opt for the Bose AcoustiMass set. Those with less to spend might find the Boston or Cambridge ensembles pleasing.

522-9011; www.yamaha.com. Circle 454 on reader service card.)

So which one should you buy? If you're looking for the best sound in this roundup and budget be damned, then you'll want to opt for the Bose AcoustiMass set. But those people with less money to spend on PC sound might find the MicroMedia or the MicroWorks ensemble just as pleasing to their ears while they're sitting on fatter wallets.—Craig L. Stark

Altec Lansing's ACS45B (\$100 street) is a slightly tweaked version of the company's popular ACS45 speaker system. The ACS45B sells for about \$40 less than the ACS48 but produces very different sound.

The ACS45B's satellites are stylish 4.5-inch cubes equipped only with volume controls. They turn on automatically when they sense a signal and shut off shortly after it stops. The subwoofer is a lunch box-size plastic module equipped with dual inputs and a bass volume control as well as a 20-watt amp and a 4-inch woofer.

Although the satellite speakers can get fairly loud, the lightweight bass unit distorts at moderate volume levels and doesn't produce much output in the deeper registers. Except for a little sizzle on top, the midrange and high-end are smooth, but the system isn't as spacious or loud as the ACS48 nor as accurate as the similarly priced PC Works from Cambridge SoundWorks.

Despite its problems in the lower registers, the ACS45B isn't a bad-sounding system. If you can't afford the ACS48 and want more volume than the Creative Labs PC Works can muster, it's worth considering. (Altec Lansing Technologies Inc., Milford, PA; 800-258-3288; www.altecmmm.com. Circle 448 on reader service card.)

BOSE CORP.

Almost as impressive as the class-leading SoundWorks is the **Bose MediaMate** (\$170 street). This two-piece system consists of a pair of elegant satellites equipped with only a master volume control and a balance adjustment for blending two inputs.

The MediaMate pair generates output that's even more detailed and realistic than that of the SoundWorks: delicate, airy sound that accurately reproduces the subtle details of fine recordings. Even without a subwoofer, the system generates acceptable output down through the upper bass, though it doesn't come close to matching its competitors' deep low-end. The satellites do suffer from a slightly fuzzy image and a cramped soundstage, but audio purists may prefer this more realistic sound to that of systems with pinpoint-sharp imaging and exaggerated spaciousness. (Bose Corp., Framingham, MA; 800-999-2673; www.bose.com. Circle 449 on reader service card.)

CAMBRIDGE SOUNDWORKS



One of the most popular PC speaker systems in recent years comes from Cambridge SoundWorks. The three-piece

Cambridge SoundWorks system (\$200 street; also sold by Creative Labs)

is the flagship entry in the company's line of speakers, and it has the highest selling price of any of the units reviewed here. Cambridge has developed a reputation for high-quality audiophile output, and during our hands-on evaluation its reputation quickly proved well-founded. If you want uncolored, full-range sound for around \$200, you'll have a hard time finding anything better.

The SoundWorks consists of a pair of tiny 3.5-inch cube-shaped satellites and

audio CDs and is arguably the most accurate product in this roundup.

The **Cambridge PC Works** (\$100 street) provides a good example of how to drop a price point without sacrificing quality. The company equips the PC Works with even tinier satellites—measuring only 2.5 inches on a side—than those of the SoundWorks but packages the bass unit in a lower-cost plastic cabinet without reducing its size.

The resulting sound isn't too different from that of the SoundWorks, providing the same type of civilized, lucid output that accurately reproduces the tiniest details. Like its bigger brother, the PC Works doesn't generate ear-splitting output levels and produces a spacious sound only when the satellites are positioned rel-

street), an inexpensive two-piece system that sounded better than some units costing nearly twice as much. The system consists of a pair of 11.5-inch-high, small-footprint mini-towers that each contain a 5-watt amp and a 3-inch high-excursion driver. Like the Yamaha System 35 and the Panasonic EAB-MPC250, the LCS-1022 includes equalization circuitry designed to enhance bass performance, and one satellite provides front-mounted volume and treble controls, a bass-EQ defeat switch, and a lighted power button.

The LCS-1022 doesn't match the volume levels, extended high-end, deep bass, or smooth midrange produced by the better systems in the roundup. But it's a relatively uncolored, pleasant-sounding



From left to right: Bose MediaMate, Yamaha System 35, Cambridge's SoundWorks, Sony SRS-PC71, Acoustic Research AR-2103, Cambridge's PC Works.

a weighty, wooden subwoofer unit. There are no controls on the satellites, but the subwoofer contains a bass volume knob and power switch, and the system includes a small master volume control on a cord that you can place within easy reach.

The satellites generate only moderate volume levels and, unless you spread them very far apart, produce a relatively narrow sound field. But none of this matters once you hear a well-recorded CD play through them. The beautifully detailed midrange and silky-smooth high-end blend seamlessly with the subwoofer's deep, tight bass.

These speakers don't produce the wall-shaking, bombastic sound favored by many game players. But the SoundWorks is an excellent choice for listening to

actively far apart. The biggest differences between the two are the PC Works' lack of output in the deepest bass registers and its slight tendency toward brittleness at higher volume levels.

The PC Works system doesn't produce wall-shaking output and thundering bass. But it does provide a reasonable approximation of the SoundWorks' superbly detailed sound—at half the price. (Cambridge SoundWorks, Newton, MA; 800-367-4434; www.hifi.com. Circle 450 on reader service card. Also sold by Creative Labs Inc., Milpitas, CA; 800-998-1000; www.soundblaster.com. Circle 441 on reader service card.)

LABTEC

One of the biggest surprises in this roundup was the **Labtec LCS-1022** (\$45

speaker with a tight upper bass. Despite its limitations, we found the LCS-1022 easier to listen to than the Sony SRS-PC71, the Acoustic Research AR-2103, or the Panasonic EAB-MPC250—all of which cost more than twice as much. Labtec also offers a subwoofer-equipped system, the LCS-2408, for \$60. If your speaker budget is tight, either system is for you. (Labtec Enterprises Inc., Vancouver, WA; 360-896-2000; www.labtec.com. Circle 451 on reader service card.)

PANASONIC

We found the **Panasonic EAB-MPC250**, which sells for \$100 (street), somewhat disappointing. Its satellites are a pair of 7-inch-high pyramids that each contain a 0.8-inch tweeter, a 3.1-inch midrange driver, and a 5-watt amp. The bass mod-

CPU PnP



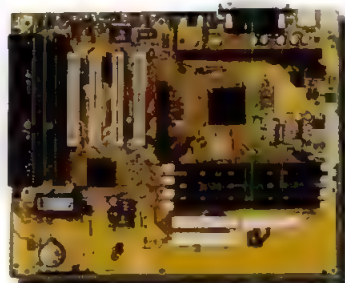
**With CPU Plug & Play motherboards,
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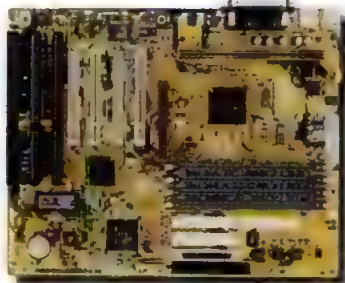
**PC Direkt (Germany)
Editor's Choice**



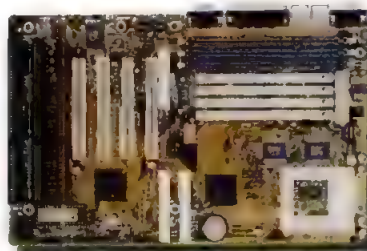
**PC Computing (Taiwan)
5 Stars Rating**



Hot-631



Hot-635



**Hot-567
(Hot-566)**



**Hot-571
(Hot-569)**



- Accelerated Graphics Port Interface (AGP)
- Slot 1 for Pentium II Processor with MMX™ Technology
- Supports PENTIUM II Processors Up to 300 MHz
- Supports 4 banks of SDRAM and EDORAM
- Configurable support for ECC
- Supports Ultra 33/DMA
- Ultra-Wide SCSI Controller available on ST-635

- CPU Plug & Play
- Low EMI (Easy CE/FCC)
- System Manager
- Power Plug & Play
- Full Memory Support
- Value Added Softwares
 - System Manager (Std)
 - Triones' Busmaster IDE driver (Std)
 - Win95-TX utility (Std)
 - Intel's LDCM (Option)



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ule is an undersize plastic box that contains a 20-watt amplifier and a puny 3.9-inch driver. The satellites are equipped with front-mounted volume and treble controls, and the bass unit provides dual inputs and a high/low switch that lets you adjust the crossover frequency to tweak bass response.

Not surprisingly, the subwoofer distorts easily and, regardless of crossover setting, produces less bottom than even the two-piece Bose MediaMate. The satellites sounded muted and lifeless, and they suffered from a cramped soundstage and blurry imaging. (Panasonic Computer Peripheral Co., Secaucus, NJ; 800-742-8086; www.panasonic.com/alive. Circle 452 on reader service card.)

SONY

Another bass-shy speaker is the **Sony SRS-PC71** (\$105 street), a two-piece system that consists of a pair of futuristic-looking 11.5-inch-high satellites. Each unit contains a 1-inch tweeter, a side-firing 2.5-inch midrange driver, and a 7.5-watt amp. Volume, treble, and input-mixing controls, as well as a power switch and head-phone jack, are mounted on the front of one satellite. On the back are two sets of input jacks and a connector for an external subwoofer.

The SRS-PC71 includes intelligent bass-boost circuitry that increases the volume of lower frequencies during softer passages, much like a conventional loudness control. Unfortunately, this feature wasn't sufficient to squeeze much bottom out of the system, resulting in virtually no mid- or deep bass.

The system's high-end is slightly veiled and suffers from upper-midrange peaks and sucked-out lower registers that add harshness during louder passages. Maximum volume levels, detail, imaging, and soundstage are all unimpressive. (Sony Electronics Inc., San Jose, CA; 800-352-7669; www.sony.com. Circle 453 on reader service card.)

YAMAHA

A close competitor to the Altec Lansing ACS48 is the **Yamaha System 35** (\$150 list), a three-piece system with a personality much like that of the ACS48. The System 35's bundled YST-MS25 subwoofer has a number of bass-customization features

that will please gamers as well as users in search of a deep, rich, atmospheric effect.

The features include a power-saving auto-shutoff function, a High Cut switch that lets you adjust crossover frequency to either tighten up or reinforce the bass, and Yamaha's YST technology, which extends low-frequency response by monitoring woofer movement and adjusting the input signal to minimize distortion. The unit's 25-watt amp and 6.5-inch driver produce deep, loud bass (although they don't match the ACS48's subwoofer in either of these areas).

The system's YST-M7 satellites are also outclassed by those of the ACS48, sounding a bit veiled and cramped in comparison. All in all, the System 35—capa-

A close competitor to the
Altec Lansing set is the
three-piece Yamaha
System 35, with a person-
ality much like the ACS48.

ble of producing decent volume levels and impressive bottom—is a good choice for game players. But it's not quite the equal of the less-expensive ACS48.

The **Yamaha System 25** (\$108 list), a three-piece model, is also equipped with Yamaha's bass-enhancing YST technology. But the System 25 omits several other major features, such as auto-shutoff circuitry and an adjustable crossover.

The System 25's tiny satellite modules are mounted on handy tilting stands, but generate disappointing sound that's muddy and veiled. In our hands-on testing, cymbal crashes lacked bite and the sound field was narrow. The subwoofer's 5-inch driver and paltry 15-watt amp provide acceptable output only in the upper registers of the bass, and the low-end is never very tight. The system's biggest problems, though, are the satellites' inability to match the output levels generated by the subwoofer and their tendency towards harshness at higher volumes. (Yamaha Corp. of America, Buena Park, CA; 714-522-9011; www.yamaha.com. Circle 454 on reader service card.) **PC**



Partners On Board

Acer America (800) 733-2257

Caliber (510) 333-1220

CompuCom (972) 856-3000

CyberMax (800) 443-9868

Data General (508) 898-5000

Dell (800) 274-3333

ENTEX (800) 597-2468

Gateway 2000 (605) 232-2000

Hitachi PC (408) 321-5000

Inacom (800) 664-9126

Ingram Micro (800) 456-8000

Inteva Microsystems (610) 770-9360

MicroAge (602) 804-2000

Micron Electronics (208) 895-3434

Mitsuba (909) 392-2000

Multimicro (514) 354-0580

New World Technologies (508) 881-4600

Nexar Technologies (508) 836-8700

Pionex Technologies (888) 974-6639

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TRAVEL WEB SITES

be your own travel agent



But don't give up your old reliable agent for one of these 15 sites—yet.

By Will Fastie

INTEGRATION

Biztravel.com, shown here, automatically knows to schedule your hotel and car rental pickup times based on your flight.

STORAGE

Biztravel.com lets you set detailed preferences for your trips and then rank your preferences.

DEALS

It also helps you arrange deals that maximize your frequent-flier benefit programs.

Trip Planner

Trip Summary

Here's a summary of your itinerary. If you want to change the arrangements for any destinations, press the "Change" button next to the destination.

Trip name: LA

First destination
Flight requested
to New York, NY (LGA) Mon, 11/10 9:00 AM
or Los Angeles, CA (LAX)

Car requested (date/time defaulted to travel times)
Hotel requested (date/time defaulted to travel times)

Second destination
Flight requested
to Los Angeles, CA (LAX) Mon, 11/11 9:00 AM
or New York, NY (LGA)

To see a complete itinerary with the flights, hotel, car, and hotel, click on the "EXPRESS ITINERARY" button.

To return to the site where you can change your preferences, click on the "PREFERENCES" button.

Travel Preferences Summary

If you want to change any of your travel preferences before you get recommendations for this trip, press the "Change" button next to the summary of your current preferences.

Flights
Sort/order preferences: Lowest price, then by closest to desired schedule, then by fewest stops
Preferred carriers: United, American, Delta
Class of service: Coach, and you will accept fares with penalties for change or cancellation

Cars
Sort/order preference: Maximize frequent traveler awards
Preferred rental agencies: Hertz, Enterprise
Type of car: Intermediate

Hotels
Sort/order preference: Preferred vendor
Preferred chains: Four Seasons, Intercontinental, Westin

FLIGHTS

You can get recommendations for the trip you desire (based on your preferences) using Express Itinerary, or craft it yourself by viewing all available flight options.

You can edit your universal preferences within any category quite easily and go right back into the reservations process.

Since the early days of PCs and modems, airlines and a number of embryonic firms have provided online reservation services. They worked but were slow, hard to use, and hard to understand—unless you happened to be an airline reservations agent. Fast-forward to 1998 and you'll find a lot of competition on the Web from a lot of companies trying to change the way we book the billions of dollars' worth of travel services we use each year. While all this activity has produced Web sites that vastly improve the friendliness and ease of use of the services from days of yore,

the answer to the ultimate question—Can you replace your travel agent and do it all yourself?—is “Not yet.” The sites are useful and interesting, but a traditional travel agent handles most arrangements more efficiently. Also, with any luck an agent won’t forget you after finding you a fare: If a lower fare comes along 2 minutes after you book yours, no travel Web site has any means of letting you know as a travel agent can.

Our review focuses on sites that let you canvass multiple airlines and book at least domestic air travel online. We covered the individual airline sites separately (see the sidebar “Fly the Airlines’ Web Sites”).

Travel arrangements usually consist of three basic types: airline seats, rental cars, and hotel rooms. While we found that almost every service did a good job getting us low fares, what differentiates them is the varying approach each site takes, surprising when you consider that you perform the same general steps to book an itinerary.

One of the services in this review, Internet Travel Network (ITN), has a site under its own name but also provides back-end services for eight of the other sites. Another, Preview Travel, provides back-end services to Excite Travel by City.Net. Despite common back-end service, each site in this

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roundup offers a different mix of features in addition to the reservations systems and has subtle but important variations in its execution of the back end. Here’s what we found in the areas we primarily considered.

Business travel. The services for business travelers on these sites are well developed. The sites that cater to business are well organized and handle the three basics very well. The better sites store a detailed trav-

eler profile, apply that profile when you are building itineraries, aggressively support your search for low fares, book cars and hotels at the same time, allow airline seat selection, offer at least some information about the locale (weather, travel advisories, places to dine), and provide an 800 number to call for problems, for payment, or to make changes while en route.

Vacation travel. We thought that vacation planning would be tremendously interesting to a wide audience, so we were disappointed that most of the sites didn’t deliver. We had hoped for the opportunity to be able to buy complete vacation packages or tours online, but the closest we could get to online buying was sending an e-mail to get more information and a price quote at the Atevo Travel site.

We also looked for “guidebook” information, the kind found in Fodor’s and Frommer’s, but we found mostly hotel brochures with no independent commentary, although some sites, such as Biztravel.com and TheTrip.com, offer Fodor’s and Frommer’s material.

Fare watching. For both business and personal travel, we thought a key advantage of Web travel services would be their ability to provide regular updates about travel bargains, especially low airfares. Most sites offer at least one means of delivering that info, whether on a page within a site, via e-mail, through a Java desktop ticker, or on a push channel

Our Contributors: WILL FASTIE is a consultant and freelance writer. JOHN GARRIS is a frequent contributor to *PC Magazine*. ALAN COHEN, TREVOR A. DAWES, JILL LÉGER, and EYAL RABINOVITCH are freelance writers. JAY MUNRO was the project leader, and DAVID LIDSKY was the associate editor in charge of this story.

SUITABILITY TO TASK: TRAVEL WEB SITES



POWER	American Express Travel	Atevo Travel	Biztravel.com	CNN Interactive's Travel Guide	Excite Travel by City.Net	Flifo	Global Online Travel
Business travel	Fair	Good	Excellent	Good	Good	Good	Fair
Vacation travel	Good	Good	Fair	Fair	Good	Fair	Good
Fare tracking	N/A	Good	N/A	Good	Fair	N/A	N/A

EASE OF USE

Business travel	Poor	Good	Good	Fair	Fair	Good	Good
Vacation travel	Fair	Good	Excellent	Fair	Fair	Good	Poor
Fare tracking	N/A	Good	N/A	Excellent	Excellent	N/A	N/A

N/A—Not applicable. The product does not have this feature.

We evaluate how well each site performs three tasks—business travel, vacation travel, and fare tracking—in terms of *power* and *ease of use*.

Business travel Factors that affect the *power* rating include the flexibility and level of detail in creating a passenger profile (preferences for food and seating, frequent-flyer information, and the like), the tracking of business specials (such as business upgrades and convention packages), and complete air, car, and hotel booking in one itinerary. We also consider the site’s

ability to change an itinerary, book companion tickets, supply local restaurant and entertainment information, and list emergency services. Additional features that affect the *power* rating include security, real-time graphical seat selection, real-time information on plane arrivals and departures, and interactive mapping services for ground travel. For the *ease of use* rating, we consider the usability of the interface, its ability to save profiles for frequent reuse, the availability of e-tickets, and the ability to manage frequent-flyer points.

Editors' Choice

- Business travel: Biztravel.com
- Vacation travel: None



Don't fire your travel agent just yet. While most sites are serviceable for booking single trips and getting low fares, only one—Biztravel.com—is filled with

the kind of features that suit the needs of frequent business travelers.

Biztravel.com offers the most detailed profile in the roundup. It particularly distinguishes itself in its management of frequent-traveler programs. While most sites can at best store frequent-flier miles from a few programs and enter them when you book reservations, Biztravel.com, through its biz-Miles feature, tracks your miles and helps you maximize awards when you book flight, car, and hotel reservations.

It gives you the greatest flexibility in updating your profile and setting multiple preferences when finding rates. And its interface is clear and helpful.

We were disappointed in the vacation services offered. Many contained the same prepackaged content licensed from Worldview Systems, and no site could give us what we truly wanted: reliable price quotes for vacations that could be purchased online. The lack of integration between the reservations systems and any resource content also concerned us.

(either Netcaster or Active Channels).

While all these services ostensibly work, their usefulness is well below what we expected. The push-based ones can't be configured and are therefore almost worthless unless you can stare at them for hours hoping to get lucky. The others offer limited criteria but have value only

for casual or the most flexible of travelers.

Our 15 reviews will give you a sense of the character and quality of each travel site. After reading them, fire up your browser and take a look. While you may be impressed with what you can do, don't forget all you can't, so don't lose your travel agent's number—at least not yet.

American Express Travel

WITH AN EASY-TO-USE reservation system, access to vacation and last-minute travel specials, and excellent customer service, American Express Travel is good for the traveler without a lot of special needs. It doesn't, however, offer the business travel extras that Biztravel.com offers—such as the ability to book flights using frequent-flier miles or to book more than five legs of a business trip.

The AmEx reservations system is powered by Internet Travel Network (ITN), but all the reservations made are sent to American Express Travel Related Services. This gives you several advantages, such as more options for purchasing tickets, including picking them up at an AmEx agency or ordering them online and having them sent overnight at no extra charge. AmEx lets you change your itinerary worldwide through AmEx offices or through its toll-free number. Ticketing is available 24 hours a day, but customer service is on a more limited schedule. AmEx does not offer additional discounts for cardholders.

Each user must register and establish a profile (identical to the ITN profile), which is stored for future use. You cannot store your credit card number from one session to another, though. The AmEx site explains the booking and payment process before you enter the reservations



Internet Travel Network



Microsoft Expedia.com



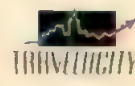
Outtathere



Preview Travel



TheTrip.com



Travelocity



TravelWeb



Uniglobe Travel Online

Good	Good	Poor	Good	Good	Good	Poor	Good
Fair	Good	Fair	Good	Fair	Fair	Fair	Good
Good	Poor	Fair	Fair	Excellent	Good	Fair	N/A
Good	Good	Poor	Fair	Good	Good	Poor	Good
Fair	Good	Poor	Good	Fair	Poor	Fair	Good
Excellent	Good	Fair	Excellent	Good	Good	Fair	N/A

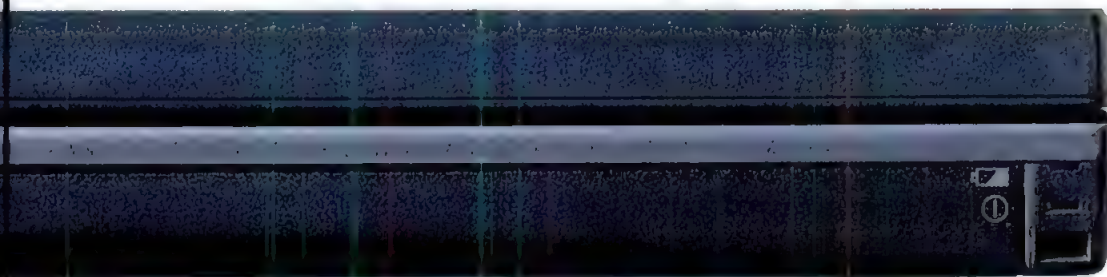
Vacation travel We evaluate the variety of options a site offers and the ease with which a user can plan and book a vacation. The breadth of tour and resort offerings, kids' specials, multiple-payment plans, online price quotes, and any discounts for online usage all factor into the *power* rating. Links to third-party content or home-grown information on locales, as well as the ability to book cars, hotels, and local tours, increase the *power* rating. We consider the ease with which a user can book and confirm an itinerary. Integration between the

travel packages and the reservation system also factor into the *ease of use* rating.

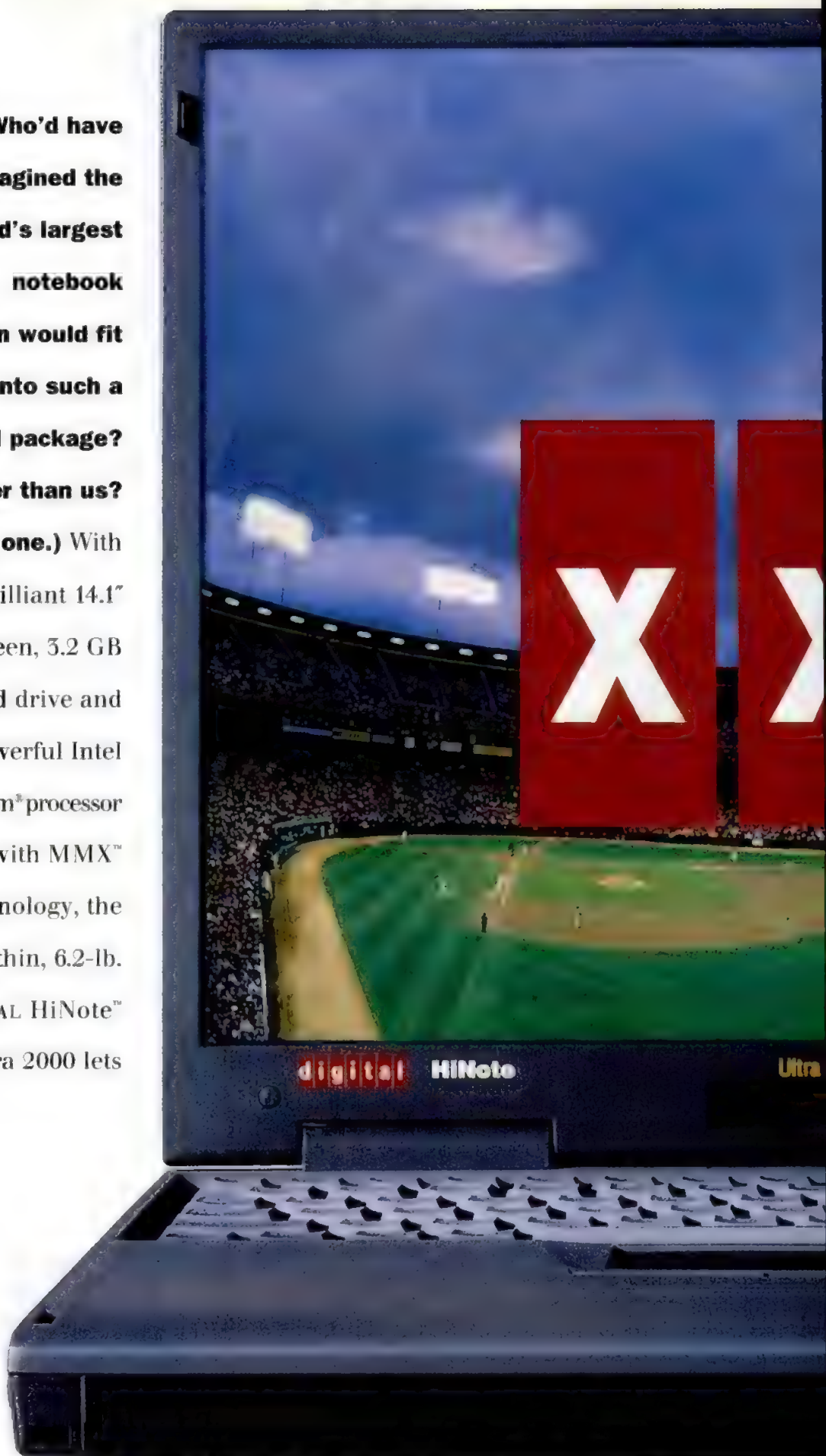
Fare tracking We rate how well a site notifies customers of low airfares. We consider how frequently the site updates its information and the options for notification that it offers. Sites that offer more granular search preferences, multiple-trip watching, and e-mail or push notification receive higher ratings for *power*. Customization of the information is also important. Intuitive interfaces, simple sign-up, and clear instructions gain points for *ease of use*.



K S



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wherever. Add
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system. While this is a good feature for first-time users, it appears each time the system is used, and it can get tedious for a frequent user.

The site's vacation packages—a service that involves many different suppliers, including Certified Vacations—are guaranteed to be at the lowest prices available.

If you find a lower price on a similar vacation special within seven days of your booking, AmEx will beat it. The drawback of the vacation packages is that the prices quoted are for fixed tours; fares will increase drastically if many changes are made. We also found some of the last-minute travel specials to be out of date.

—Trevor A. Dawes

American Express Travel. American Express Travel Related Services Co., New York; 800-346-3607; www.americanexpress.com/travel/.

Atevo Travel

FOR A FUN AND well-organized Web site that offers a community for travelers beyond its core reservation booking system, look no further than Atevo Travel. Highlights include a travelers' bulletin board, spotlights on particular travel destinations, and even electronic postcards.

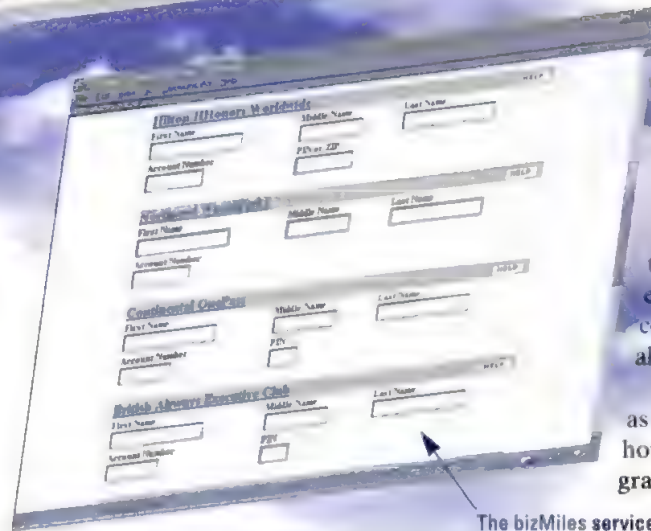
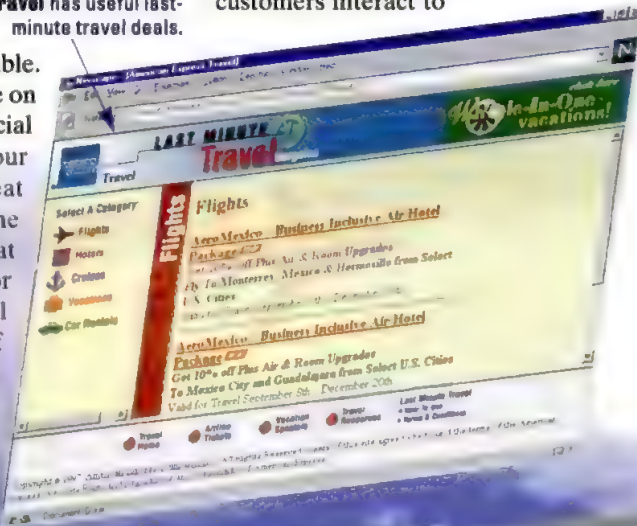
Atevo uses the Internet Travel Network (ITN) reservation system to give price quotes and book reservations. As with Outthere, you don't need to create an Atevo account to get fares, but going through the free registration process lets you specify flight preferences, such as seat type, meals, and frequent-flier numbers. When you book a ticket, you can select your seat in real time using a Java-based seat picker that some of the other ITN-network sites, such as AmEx and CNN, don't offer.

Atevo advertises a number of package deals and cruises, and it offers spotlights on popular travel destinations such as Athens and Hawaii. Unfortun-

nately, the package deals aren't very well integrated into the system: You can't get price quotes for those packages online. Instead, you have to fill out an online form to have an Atevo agent call you back.

Atevo does a better job with helping its customers interact to

American Express Travel has useful last-minute travel deals.



share information about their travel experiences. It has a bulletin board, called Travelers' Exchange, where travelers can post messages asking questions about particular travel destinations or travel topics. Atevo has "Travel Experts" that answer questions you may have about destinations across the world.

Atevo also has an extensive photo gallery and a clever application that lets you send digital postcards over the Internet. All in all, Atevo's a good place to visit if you're planning a vacation and are looking for ideas to help you plan your travel.—John Garis

Atevo Travel. Atevo Travel Inc., Burlingame, CA; 650-652-1000; www.atevo.com.

Biztravel.com



THROUGH EVERY aspect of its service, Biztravel.com tailors its features to the frequent traveler. It consistently delivered low fares, and its profile lets you manage all your travel concerns. Biztravel.com's bizMiles feature also lets you track all your frequent-flier points packages in one place, and you can even schedule your travel to take full advantage of such programs through bizReservations. You won't find a fare tracker here, and vacationers looking for packages, promotions, side trips, and the like won't find them, but anyone who travels often will find that Biztravel.com's extensive and flexible service makes it the best of the online travel agencies.

Biztravel.com's profile is as complete as those that travel agents request and one of the most extensive among all the sites in this roundup. The profile lets you enter as many frequent-flier, -driver, and -sleeper program numbers as we can think of, and you can even enter corporate discount numbers. Only Flifo also offers this feature.

Perhaps as impressive as the complete profile is how Biztravel.com integrates these features into the reservations system. You can specify whether you want to give preference to the

The bizMiles service in Biztravel.com lets you enter the information for every traveler service you use.

lowest fare, the airline, or flights that hew most closely to your stated departure and arrival times. All of these features can be changed easily while you are in the process of planning a trip.

A feature that will appeal to frequent business travelers is Biztravel.com's mileage optimization. When you set your profile, you can specify goals for each program to which you belong. Biztravel.com uses this information to suggest itineraries that will help you meet these goals. You can tell Biztravel.com to select itineraries

ESSENTIAL travel resources

When planning a business trip or vacation, you need to worry about more than just booking your ticket. Here's a list of some handy travel-related Web sites to help you along every step of the way.



A visit to The Weather Channel (www.weather.com) tells you everything you would ever want to know about the weather—and more. You can get current temperature and extended forecasts for every major city in the world, as well as updated satellite and radar maps for domestic cities. You can even type in your flight number and have The Weather Channel look for reported delays. • If you have a morbid fear of hurricanes, tornadoes, or other natural disasters, check out the National Weather Service (www.nws.noaa.gov). Among other things, it lists all official weather warnings throughout the country. It also has more technical information about the weather to impress even your meteorologist friends.

If you're traveling outside the U.S., go to the U.S. State Department Travel Warnings page (travel.state.gov/travel_warnings.html) to get the latest official recommendations about traveling to any country, including travel warnings and important facts about obtaining visas. • For travelers' health tips and guidelines, go to The Centers for Disease Control (www.cdc.gov). This site tells you everything about getting immunized for foreign travel and also publishes reports of disease outbreaks worldwide. • The Universal Currency Converter page (www.xe.net/currency) provides an easy way to convert between any two currencies.



Looking for a good place to eat? Zagat Survey (cgi.pathfinder.com/cgi-bin/zagat/homepage) is the place to go. Zagat reviews an impressive array of restaurants throughout the country. For each restaurant, Zagat rates food, decor, and service, as well as the average cost as reported by Zagat reviewers. And the reviews are usually on target. [dine.com](http://www.dine.com) (www.dine.com) also has a good list of user-submitted reviews of restaurants nationwide, although some cities (such as San Francisco) are much better represented than others.

If you go to MapQuest (www.mapquest.com), you'll be sure never to get lost in a strange city again. This online mapping service gives you door-to-door directions between any two addresses in the country. You don't even need to know the exact address; you can just type in a city and a place of interest (such as "amusement park" or "hospital") and it will give you a list of possible places to go. • If you get lost on your way, try Road Watch America Direct (rwa.metronetworks.com/rwadirect.html). It has links to local traffic sites throughout the country. Some of the traffic reports (such as Seattle's) are very useful, but we did find that others (such as New York's) lacks sufficient detail.



If you do business on the road, you know how hard it can be to send a fax when the need arises. But now you can do it on the Web. Using Faxaway (www.faxaway.com), an Internet-based faxing service, you simply compose an e-mail and send it to target_fax_number@faxaway.com, where *target fax number* is the number of the fax machine. You have to subscribe to Faxaway first, but the rates are competitive. Faxaway also works with MIME attachments to let you send word processor documents or images.—John Garriss

that maximize your awards and seek specific kinds of awards.

Biztravel.com's interface is clean and efficient, but its thoroughness in walking you through planning an itinerary is sometimes too careful. For example, all flight segments are entered one at a time. Biztravel.com never presumes that you are simply booking a round-trip ticket.

Frequent business travelers should look no further than Biztravel.com for booking flights online.—WF

Biztravel.com. Biztravel.com Inc., New York; 800-835-6483; www.biztravel.com.

CNN Interactive's Travel Guide

WITH AN EASY-TO-USE reservations system, an effective low-fare tracking system, and the valuable CNN online guidebook, CNN Interactive's Travel Guide is useful for any business traveler. No vacation deals are available through the site, though—only air, car, and hotel reservations.

The booking section, known as Reservation Desk (www.reservationdesk.com), offers such extras as letting multicity travel-

ers book up to seven legs on a trip. The fares obtained through CNN matched what we found directly from the airlines' sites.

We found CNN Travel easy to use and maneuver. Powered by ITN, the reservations system is almost foolproof, since you don't need to know airport symbols or travel agent codes as you do at Travelocity.

CNN offers two very good ways to monitor low fares when you're not booking travel. You can specify routes of interest, the approximate fare you are willing to pay, and how frequently and for how long e-mail should be sent to you when routes

are available for the stated fare range. You can also watch a Java low-fare ticker that runs in a separate browser window on your desktop. The examples tested were all available, albeit generally for dates at least one month in the future.

All changes to an itinerary after it has been booked must be made over the phone via ITN's toll-free number. Because reservations are sent to ITN, you don't have the worldwide capability to change your reservations after travel has begun, as you can with AmEx.

The wealth of information the CNN site provides is very useful. The one link to the cable channel contains online versions of features produced for CNN's weekly travel program.—*TAD*

CNN Interactive's Travel Guide. CNN Interactive, Atlanta; 800-253-9822. www.cnn.com/Travel.

Excite Travel by City.Net

WANT TO KNOW WHAT it's like to stroll through downtown Bangkok? Excite Travel by City.Net is the place to find out, with its thorough and well-presented coverage of every city from Albany, Georgia, to Zurich. This is an excellent information resource for both business and pleasure travelers but not as effective for booking travel.

The site's myriad extras are still quite helpful, particularly for international travel. Most impressive is the Travel Essentials area, which houses facts on cities around the world. Here you'll find information on everything from passports and vaccination requirements to recommendations for restaurants, hotels, transportation, and places to go sightseeing. Travel Essentials also offers plenty of real-world information on things like water quality and etiquette. City.Net's package of resources is more compelling than the Worldview Systems package used on most ITN sites.

A world map at the top of the home page lets you pull up information on some 5,000 destinations. Click on an area or type in a location and you're taken to a list of internal sites and map links. In case you're interested in travel books, you'll find plenty of links to Amazon.com, and a travel-news area offers a timely if random

assortment of articles, broken down into categories like Business Travel and Frequent Flyer Miles. City.Net also offers a place to engage in travel-related chat, but we found that its efforts at community building were not as successful or useful as we found at Atevo.

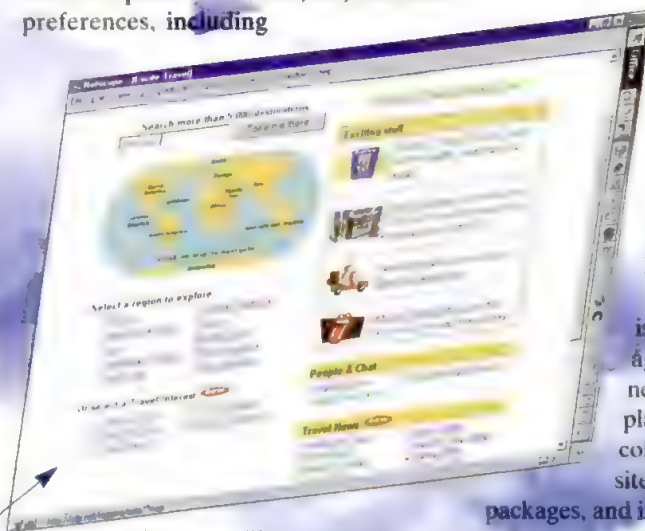
City.Net's reservation area is powered by Preview Travel, and the same features are available here, with the notable exception of deals on vacation packages. (See the Preview Travel review for more information.)—*Jill Léger*

Excite Travel by City.Net. Excite Inc., Redwood City, CA; 650-568-6000; city.net.

Flifo

IF YOU ARE A frequent business traveler, Flifo is a good place to learn about where you're going and to set up a well-organized, detailed itinerary. But its lack of a fare tracker and its offering the same travel packages available elsewhere keep it from being a premier site for vacation planning.

Flifo has one of the more detailed and rich profile forms. You must complete a profile to access any information, but with the option to enter air, car, and hotel preferences, including



frequent-flier and corporate account numbers, business travelers will appreciate the value returned for the effort. Only Biztravel.com had profile options as impressive as Flifo's. All of your profile, including preferred payment options, is held securely via SSL.

Like many of the ITN sites, Flifo has a Fare Beater that will find the lowest rates available given your personal constraints and preferences. Flifo integrates all of

your reservations for a given trip into one itinerary, which you must then book or cancel, though you could choose to call Flifo directly and book by phone.

Flifo's plane-ticketing plan is especially convenient. As with Travelocity and Biztravel.com, you can either have an electronic ticket processed or have Flifo send you a ticket by mail. If you choose the latter, Flifo will deliver your ticket to you free, even if it requires express mail.

The site includes two other sections. One, similar to ITN/TheTrip.com offering, checks on arrival and departure times of current flights. The other, Travel Zone, includes travel features, destination descriptions, and useful travel services like downloadable maps and a currency converter. Much of Travel Zone's content comes from Worldview Systems.

—*Eyal Rabinovitch*
Flifo. Travelogix Inc., Houston; 800-545-3999; www.flifo.com.

Global Online Travel

THIS NO-FRILLS SITE offers fast access to travel information. Though acceptable for making simple flight, hotel, and car reservations, Global Online Travel (GOT) lacks many of the basic features—such as fare tracking and a profile—found on other sites supported by Internet Travel Network.

Its most notable offering is a discount on travel packages available through partner sites. This is not vacation planning per se but rather a collection of links to Web sites where you can shop for packages, and if you book through GOT, you can get 5 percent cash back. You can't book packages online, though; you must call or e-mail GOT to make the purchase.

GOT doesn't make you register or log on before supplying pricing information, even when you're entering secure mode. Navigation is intuitive and quick, and you can alter your itinerary easily at any time, tacking on extra legs or adding car or hotel reservations. Unfortunately, you cannot create a personal profile, so travel prefer-

Use **City.Net** for getting important travel info for every city from Bangkok to Birmingham.

Airlines' Web Sites

You want to get the lowest fare available for your flight. On the surface, going to an individual airline seems less efficient than going to a reservations network that canvasses the fares of all the airlines. But that's not always true: Sometimes the airlines give you enticing incentives to book your travel through them.

As a test, we looked for the cheapest round-trip fare we could find from San Francisco to London. Using Atevo (an ITN site), our lowest fare was \$917. At the American Airlines site, the fare was \$732. Next we tried Virgin Atlantic and got a quote of \$890—still cheaper than Atevo's price.

Airline reservation systems are so complicated that trying to figure out why one system may show cheaper fares than another is not worth the effort. But when you're on the Web, you're just a few seconds away from a quote, and going to another site may save you hundreds of dollars.

You should check out the Southwest Airlines site (www.iflyswa.com), especially be-

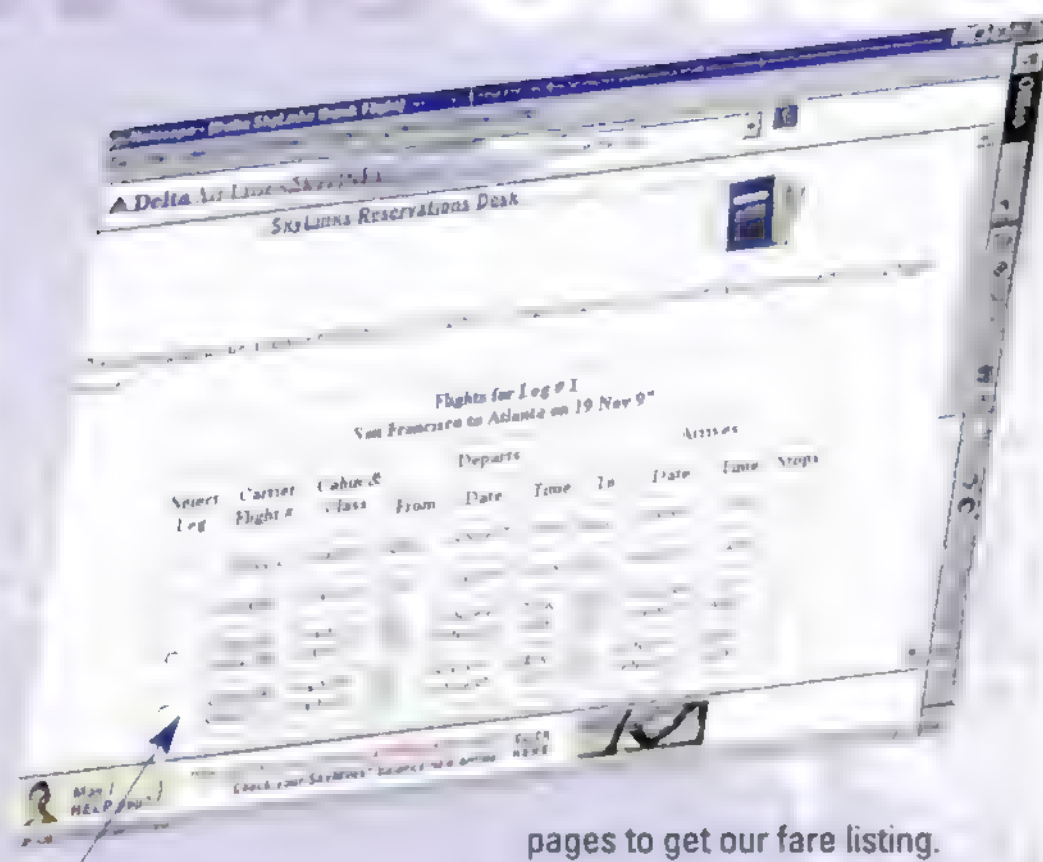
cause most of the travel agencies don't show Southwest fares when they search their airline databases. The Southwest site is clearly laid out and makes finding the lowest fare an easy task. And Southwest is offering double credit for its Freedom Rewards members when they purchase tickets online.

Some of the airlines do a much better job than others at providing quotes and booking fares. The Delta Airlines (www.delta-air.com) and Virgin Atlantic (www.fly.virgin.com) Web sites are easy to use: You can get quotes within seconds of getting to the Web sites and also book the fare online. The American Airlines site (www.americanair.com)



is also well designed and easy to use, but you can't actually book a flight on the Web unless you're already an AAdvantage member.

The airlines with the most sophisticated Web sites, which most closely resemble the travel sites in this roundup, are Continental Airlines (www.flycontinental.com), Northwest



Delta Airlines' site features a clean interface and easy access to fare quotes.

Airlines (www.nwa.com), and TWA (www.twa.com). These systems are also more complicated than what Delta and Virgin offer; they require log-ons and can store multiple itineraries. The Continental and Northwest sites were created with the help of Microsoft Consulting Services and look almost exactly like Microsoft Expedia. Although they're intuitive, it takes time to navigate through the many Web pages just to get a simple fare quote. For example, using Northwest, we had to go through six Web pages to register and another eight

pages to get our fare listing.

At the opposite end of the spectrum is US Airways (www.usairways.com), which doesn't offer online reservations or fare quotes. Just one step above is United Airlines (www.ual.com), which doesn't track fares over the Web but instead offers a proprietary Windows package that you can download from its site. In addition to being Mac- and Unix-unfriendly, United requires a lot of extra effort.

Airlines often offer incentives, such as bonus miles, for people who book directly through their online services. But airline sites let you book only the flight, while travel sites can handle other aspects of your trip.—JG

ences and basic information must be reentered every time you book a flight.

Making reservations is easily done online; you don't have to call unless you want to change an already booked itinerary (live telephone operators are available around the clock). GOT's Low Fare Shopper will automatically scan for alternative flights that beat the fare you select and list them under your choice. And GOT lets you book an itinerary without a credit card number; it offers to hold the reservation until you've called the number in to a GOT agent.

The site's Global Spotlight area pro-

vides links to sites on everything from weather to currency exchanges, and editorial travel-guide content—some of which is a little dated—offers information on major travel destinations.—JL

Global Online Travel. Signature Travel Services, Schaumburg, IL; 800-775-1840; www.got.com.

Internet Travel Network

A GOOD BUSINESS TRAVEL SITE, Internet Travel Network (ITN) is well suited to performing most of the basics for a busi-

ness traveler in a very clean atmosphere. It lacks some profile features that distinguish a Biztravel.com or a Flifo but otherwise holds its own with a real-time flight tracking, a Java-based fare ticker and seat chooser, and low-fare notification via e-mail. While all the other sites in this roundup that use ITN as their reservation system offer some ancillary features that ITN doesn't, no single ITN site offers all the features that ITN does.

One strong ITN feature is that you can associate your online efforts with a travel agency in your locale. Ideal for the busi-



Harvey

Christian Murphy was non-verbal. He lived with a wall between himself and the world.



1 THIS IS CHRISTIAN
He can see, hear, feel, touch,
but he cannot speak. He was born
with autistic tendencies that cut
him off from the world around him



Harvey



2 A TEACHER DISCOVERED that Christian would respond to images from his life. She put visual cues to the story of his new puppy on a special keyboard.

3 THE MONITOR BECAME HIS VOICE. With it he makes class reports and conversation. With it, Christian, 11, has been in the regular Osterville, MA public school since first grade.



→ **Until he found this window.**



4 WITH THE PICTURES, HE MADE SENTENCES. With the sentences, he made friends. Christian's monitor is the window between his non-verbal world and the speaking world of his friends. Through it, he teaches them many things.



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E500	1280 x 1024 (@ 65Hz)	119MHz	CROMACLEAR	0.25mm mask
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INTERNET

Travel Web Sites

ness traveler, this provides a location to pick up travel documents in a hurry and a place to call for changes en route. It also provides a safety net for any online snafus. It takes only four or five mouse clicks to choose an agency, whose name then appears on your ITN home page.

Creating an itinerary goes quickly. You can get started without a profile; just enter your desired destination and click on "Fly To." ITN saves your home airport as part of your registration. You can add your profile information after you've selected a flight, although not as easily as on Biztravel.com. You can create a trip with up to seven legs on the same itinerary.

For a site focused on business travel, ITN has one noteworthy shortcoming: It stores only four frequent-flier numbers and no car or hotel program numbers. And although you can access the standard Worldview Systems resource and travel package information, it is off to the side under "Internet Travel Guide."

With some fine tuning, ITN would appeal more to serious business travelers.—WF

Internet Travel Network. Internet Travel Network Inc., Palo Alto, CA; 800-253-9822 (or use an associated local travel agent); www.itn.net.

Microsoft Expedia.com

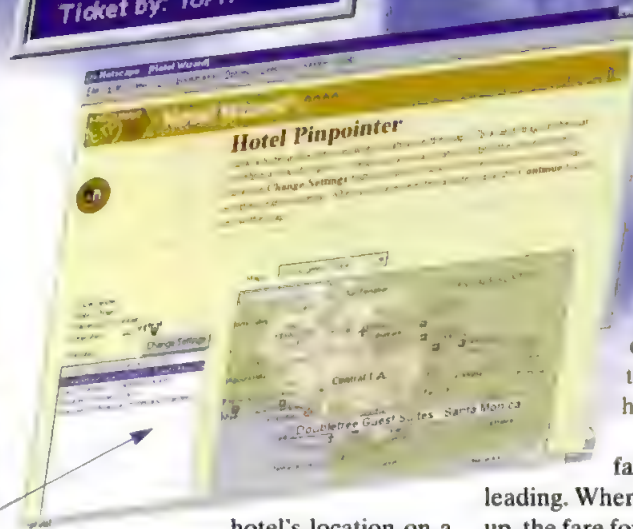
A WELL-PRODUCED SITE featuring the extensive wizards and all the interactive bells and whistles you'd expect in a Microsoft product, Microsoft Expedia.com lets you book flight, car, and hotel reservations without much difficulty. The site does not offer much in the way of vacation content, but for that quick business jaunt to Cincinnati, it's very efficient. Continued use of the site, though, reveals some design flaws and thinner feature sets than you might guess from its slick appearance.

We found it disconcerting, for example, that once you enter into any wizard, you lose the navigation bar for going to any other part of the site. Biztravel.com and Outtahere let us get to any section of

the site from anywhere in the service. And although the wizards are helpful for beginners, they tend to overextend the process you need to do to complete a task.

The wizards do exhibit some of the more impressive interactive features available on a travel site, including Seat Pointer and Hotel Pinpointer, both Java-based apps. With the unparalleled Hotel Pinpointer, you can view a

The Java-based ITN fare ticker can keep you up to date on low fares right from your desktop.



hotel's location on a map instantly so that you can choose the one closest to where you want to be.

Expedia.com is really a business travel service, but it doesn't deal in the kind of detail that Biztravel.com and others do. For example, you can set up only a five-leg multi-city itinerary—unlike with CNN Travel, which offers seven, or Biztravel.com, which allows an unlimited number of legs. You can set a few filter points for hotel amenities, but the list is paltry compared with TravelWeb's.

Expedia.com's fare-tracking service is

perhaps the most spartan of any site here. You can track only three routes for e-mail notification, and you cannot specify price triggers, frequency requests, or specific airlines as you can with any ITN fare mail site. Expedia.com is easy to use, and some of its interactive extras are impressive, but it can be cumbersome when you have to plan a difficult business trip or want more business-friendly features.—WF

Microsoft Expedia.com. Microsoft Corp., Redmond, WA; customer service via e-mail, or 404-728-8787 en route; www.expedia.com.

Outtahere

SPEND SOME TIME at this site and you'll be out of there all right, probably to a better Web site. We found this site disappointing considering that ITN and Worldview Systems provide the reservations system and content for many of the sites in this roundup. But Outtahere's performance is sporadic when doing basic tasks such as recalling your profile or past reservations.

We were disappointed with Outtahere's inability to handle the basics of Internet customer service. You don't get e-mail confirming reservations, and the confirmations were sorely missed when the site's Previous Reservations section could retrieve only one of the several reservations we had made.

Outtahere's system of fare quotations can be misleading. When a list of flights first comes up, the fare for each is noted as being "as low as" a certain amount. Select a flight, however, and the actual price is often much higher. A site such as Biztravel always warned us when the quoted fare was solid and when it might change.

Perhaps the most notable feature of Outtahere is its profiling. Profiles are rather detailed and can be easily modified: You can select from some 20 meal options, for example, from raw vegetarian to gluten-free. Unfortunately, Outtahere pulled our preference data into reservation forms inconsistently.

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INTERNET
Travel Web Sites

Outtathere has the e-mail-based fare-watching feature that ITN makes available to its sites, but its implementation on Outtathere is not as good as elsewhere.

Unlike AmEx or GOT, Outtathere is not the place to search for vacation packages. Unfortunately, with its poor interface and haphazard memory, it is not the place to book one, either.—*Alan Cohen*
Outtathere. Internet Travel Network & Worldview Systems Corp., Palo Alto, CA; 800-253-9822; www.outtathere.com.

Preview Travel

OFFERING AN EXTENSIVE collection of vacation packages and support for multiple profiling, Preview Travel is an above-average site geared toward both business travelers and vacationers but with a strong consumer orientation. It is well laid out and stylish in its presentation but does not possess one compelling feature to recommend it over any other site.

Travelers who can plan around low-fare availability will like Farefinder. The Farefinder page is updated four times a

day; it has valuable low-fare news and an excellent search capability for cheap flights about a month in the future. Although you get to specify which airports are convenient for departure, you cannot select particular cities; your search choices are limited to U.S. cities, international cities, and vacation specials.

Vacation specials are a prominent aspect of Preview Travel's service, and while this is one of the best sites for vacation package information, we still couldn't book anything online, and the tentative price quotes did not include airfare costs.

Preview Travel stores an above-average profile, more detailed than ITN but less extensive than Biztravel.com or Flifo. It lets you store hotel preferences and frequent-flier numbers, although not a credit card as with most other sites. It is one of the few sites that lets you create multiple profiles, so we could tailor one profile for business, one for travel, and a third for a significant other.

One particularly welcome feature was the ability to widen your travel parameters by selecting morning, afternoon, or

evening when stating flight preferences rather than a single time.—*WF*

Preview Travel. Preview Travel Inc., San Francisco; 800-989-9200; www.previewtravel.com.

TheTrip.com

THETRIP.COM HANDLES the basics of booking a trip well, letting business or pleasure travelers plan trips without hassles. But since it lacks extras such as interactive bulletin boards or vacation package deals that would make it ideal for leisure travelers, you might find other sites like Atevo or Expedia.com more entertaining.

TheTrip uses Internet Travel Network (ITN) to reserve and book flights but services your reservations itself if necessary. We found it fairly easy to use, and we liked that we could group all our flight, car rental, and hotel reservations in a single itinerary. A word of warning: ITN isn't picky about particular airports within a given city, so make sure that the flight you book actually goes to the airport you want to use.

TheTrip's city profiles and hotel

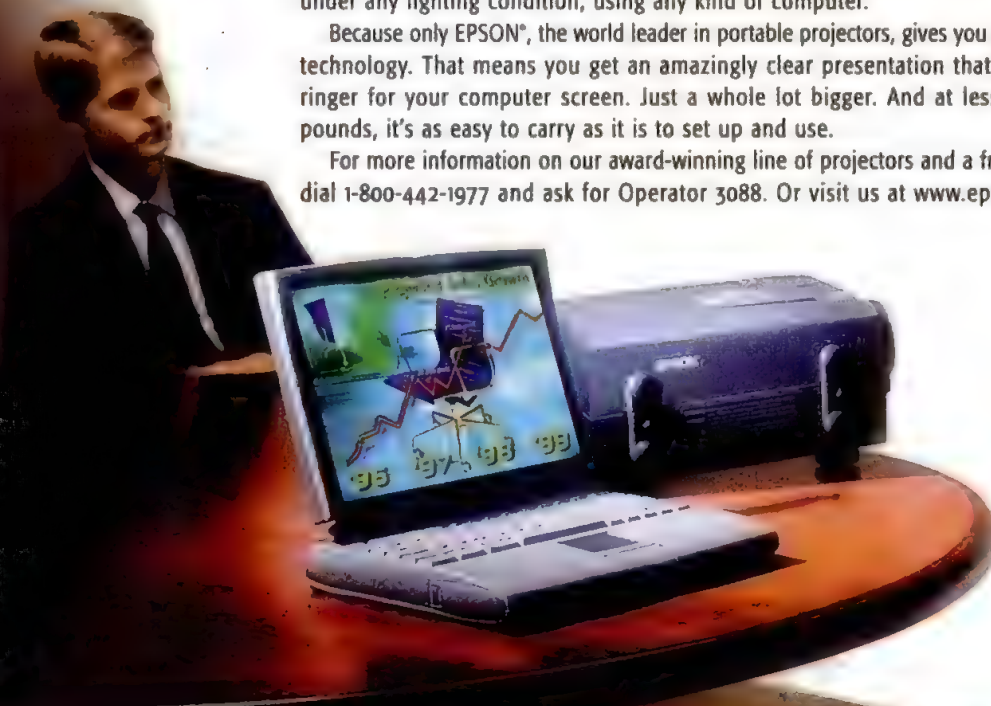
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reviews are a useful complement to its flight-booking system. For more popular cities, TheTrip uses Frommer's guides to provide hotel and dining recommendations. For other cities, TheTrip provides more generic city overviews, which we found somewhat useful although a bit stale. If you're a serious traveler, you'll be better off investing in a traditional city guide.

You can have TheTrip's e-mail service automatically update you on low fares for specific flights. Unlike many of the ITN sites whose fare mail limits you to tracking five flights, TheTrip lets you select up to ten flight routes and have it monitor those routes for low fares. TheTrip doesn't, however, advertise any special vacation packages or promotional discounts.

Even if you never book a flight on TheTrip, you'll find its free flight-tracking

service a great utility. Type in an airline and flight number and it tells you where the flight is, anywhere around the world. The site includes a graphical Java-based topographic map and tells you whether a flight has



taken off, is in the air, or has landed. Although this service is also available on ITN, we found it easier to access and use here.—JG

TheTrip.com. TheTrip.com Inc., Englewood, CO; 888-484-3874; www.thetrip.com.

Travelocity

WITH ITS USER-FRIENDLY design, superb customer support, and excellent knack for finding low fares, Travelocity will get you to your destination as cheaply and painlessly as possible. But because it has no vacation packages, it is best suited to business travelers.

Travelocity is Sabre's Internet version of its reservations network. While most sites handled low-fare finding pretty well, Travelocity consistently found fares that couldn't be beaten on the airlines' own sites. We liked being able to set numerous ranked criteria (by price, time, airline, or number of stops) when searching for fares.

You can create profiles for both business and pleasure, which only Preview Travel can do as well, and you can store all your frequent-flier numbers for air, hotel, and car rental. Unlike Biz-travel.com, Travelocity will not let you track the miles you've accumulated in a host of frequent-flier programs. You



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INTERNET

Travel Web Sites

can, however, have your flight information sent directly to your pager—a handy feature.

We liked Travelocity's fare-watching feature but found the system too inflexible. You can have Travelocity monitor up to five separate trips; when a corresponding fare changes by \$25, you get an e-mail. Unlike the ITN fare mail, however, Travelocity doesn't let you set "target" fare levels. You can't say something like "Let me know when the Chicago/Newark fare nears \$150."

Travelocity too often shows its roots as a travel-agent reservations system. Hotel descriptions often contain cryptic jargon such as an Extra Fees box that reads "RA NA RC NA CR 0.00 EX 25.00." You get a cryptic code with flights, too, and while this is not as intrusive with air travel, it's still potentially distracting.—AC

Travelocity. The Sabre Group Inc., Fort Worth, TX; 817-963-3372; www.travelocity.com.

TravelWeb

TRAVELWEB OFFERS an excellent level of detail in searching for and booking a hotel, but in other areas you'll find other sites more useful. TravelWeb is poorly integrated and doesn't have as many attractive features as Biztravel.com and Expedia.com.

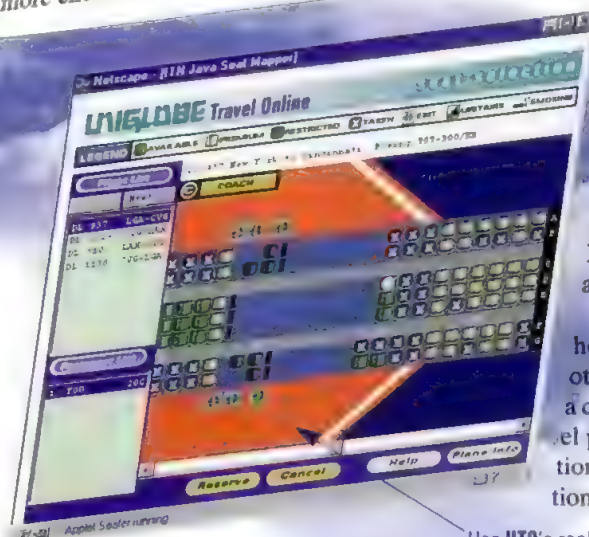
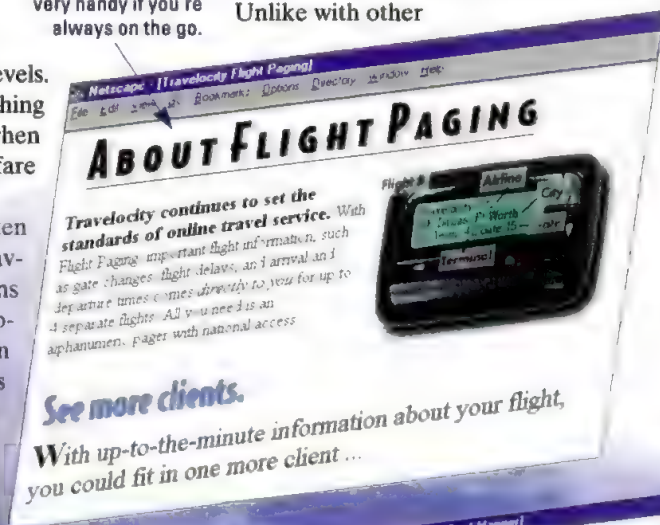
TravelWeb does have the best hotel search and reservation feature in this roundup, however. Though it's not as interactive as Expedia.com's Hotel Pinpointer, it gives you a more detailed search form that lets you specify amenities for an extensive database of hotels worldwide. The hotel database focuses more on large hotel chains, though, so if you're looking for a quaint bed-and-breakfast you might be better off using Travelocity, which has a specialized B&B section.

Although TravelWeb uses ITN to handle flight reservations, it's not as user-

friendly as some of the better ITN sites, like TheTrip.com. For example, you cannot register with TravelWeb and have it store your flight preferences, such as home city and preferred airlines. Since TravelWeb can't link all your past flight inquiries to your user name, this makes it hard to track saved itineraries.

Furthermore, booking flight and hotel reservations are two separate processes. Unlike with other

Travelocity can send all your flight info right to your pager—very handy if you're always on the go.



friendly as some of the better ITN sites, you can't pay for your flights and hotel accommodations in a single electronic transaction. And at press time, TravelWeb is the only site in this roundup not set up to handle car rentals.

TravelWeb doesn't offer any package travel deals, but it does have some services for bargain hunters. The Click-it! Weekends service makes it easy to find low hotel fares for the upcoming weekend.

Overall, TravelWeb needs to add more features to be competitive.—JG

TravelWeb. Pegasus Systems Inc., Dallas; 800-221-1144; www.travelweb.com.

Uniglobe Travel Online

WITH SPECIAL SECTIONS for cruises, packaged tours, and getaways, Uniglobe Travel Online complements a basic reservations system with some useful vacation extras. Though it does not offer a fare-tracking service for long-term travel planning, it is a good choice for finding low rates and fares.

Uniglobe, an ITN member, makes it easy to book a trip, with an excellent online demonstration of each step. You do have to register with Uniglobe to make any air, hotel, or car reservations, and you can set up an extensive user profile to identify your default travel preferences. One of the more useful flight reservation extras is the "expert" availability format, which breaks down seat availability on a flight according to the fare class so that you can see whether seats are left in a specific price range.

While Uniglobe's reservation system largely resembles those of most of the other ITN sites in the roundup, only it and Atevo have the Java-based seat picker that ITN offers. Oddly, Uniglobe doesn't have either the Java low-fare ticker or the e-mail low-fare notification found in most ITN sites, such as CNN, ITN, and Outtahere, have.

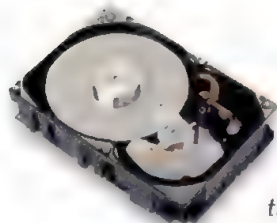
Besides the air, car, and hotel reservations common to other ITN sites, Uniglobe offers a collection of predesigned travel packages in its Hot Spot section and a range of accommodations close to a prechosen general destination in its

Getaways section. After you select a package, a Uniglobe agent contacts you by e-mail or phone to confirm availability and booking.

Besides Uniglobe's reservations options, the site includes an array of travel information from Worldview Systems Corp., parts of which are shared by some other ITN members and almost all of which are also found in Flifo.—ER
Uniglobe Travel Online. Uniglobe Travel Online Inc., Seattle; 800-886-2010; www.uniglobe.com. PC

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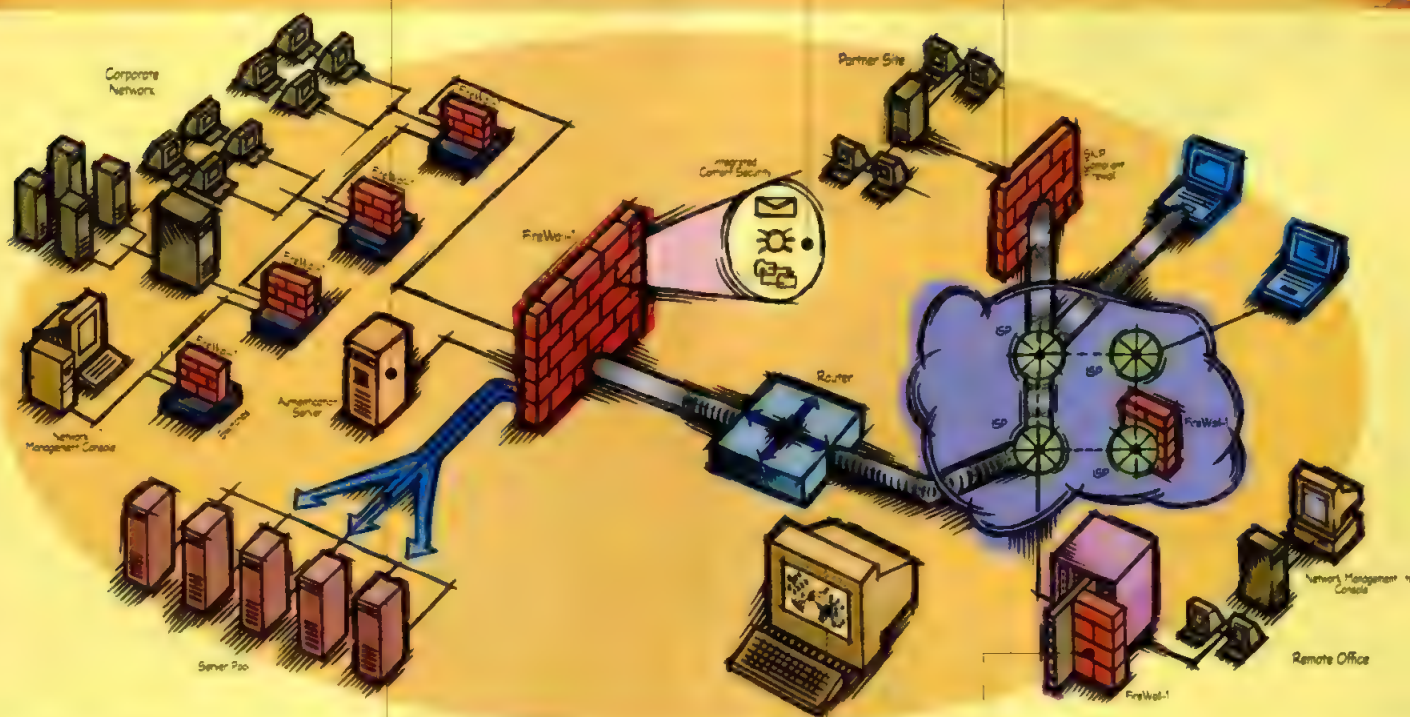
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3	Network:ANY	Network:Telnet	Telnet	Block	Account	Outbound
4	Trusted_Zone	Network:ANY	http,ftp,java,ActiveX,Web_Video	Block	Alert	Outbound
5	Network:ANY	Network:Telnet	Telnet	drop	GroupTree	NY Router, Tokyo Router
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FireWall-1

Net Tools



Building a Net Toolbox

Here's a toolkit that controls the technology, charms the sociology, and limits the luck you need to create a killer network.

By Frank J. Derfler, Jr.

In networking as in life, tightly knotted problems often have simple, sharp solutions. We've dedicated this edition of Net Tools to helping you find those solutions—at least for the networking part. We've gathered more than a dozen nifty tools for solving problems or improving productivity in networks and communications systems. In some instances, they're products such as the Konexx Koupler that are unique in the market. In others, they're products such as the APC MasterSwitch that are not alone. We have chosen what we think

are the best of the lot. Initial cost and long-term value played a big part in our tool-selection process. The products are organized according to the life cycle of network—planning, installation, use, and support. In many systems those phases are simultaneous, but the functions of each are unique.

A network is never any better than you plan it to be. The best common ground for planning is a network diagram, but instead of squiggly lines on a whiteboard, how about using a diagramming tool that brings some knowledge to the subject. Drawing tools let you diagram, lay out, and proof

INSIDE

NETWORK TOOL KIT:

Keeping a network sleek and fine-tuned requires the right set of tools. Senior networking editor Frank J. Derfler, Jr., contributing editor Steve Rigney, and contributor Craig Ellison have put together a toolkit that will keep you and your network healthy and happy.



NOS EXTENSIONS: Microsoft and Novell are duking it out to see who can provide the most complete package of network services. Steve Rigney takes a good, long look at Microsoft Proxy Server 2.0 and Novell's BorderManager. *Page 211.*



MINI-WEB SERVERS:

Though they sound too cute to be true, Compact Devices' Twister and Micro-Test's WebZerver aren't cream puffs. Contributor Jeff Witt put these network devices through their paces. *Page 213.*

CD-ROM SERVERS: Our tireless Steve Rigney looks at Hewlett-Packard's CD-ROM Server and Realm Information Technologies' Universal Server, which provide ways to share your CDs. *Page 214.*

INTERNET TOOLS:

Contributor Robert Lipschutz untangles the intricacies of the bandwidth-conserving IP multicast standard. *Page 219.*



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a proposed network with precision because they contain templates for specific pieces of equipment. Several good products are in the market, but in our toolbox we went for the value of Visio Professional.

New networks generally grow from the bones of old networks, but making connections from old to new can be a problem. Special adapters and connectors, like those from Allied Telesyn, can link older cabling to newer and solve interface problems. New networks also face the timeless threats of lightning hits and power surges, so it's wise to plan on inserting surge protectors on the LAN, telephone, and printer cables.

In the installation phase of a network, our experienced contributing editors tell us, nothing gives as much trouble as insuring the quality of the cable connections. The Mod-Tap SLT-3 cable tester is an inexpensive, fast, and simple tool for checking cable connections. When you need to know more about a network cable run, we suggest reaching for the Fluke OneTouch Network Assistant. Its screen quickly tells you about the quality of the cable and the connections to networked devices.

After you've planned and installed your network, the payoff comes. File and print sharing are the immutable basics of networking, but intranets, Internet connections, and computer telephony also add value. Our toolbox includes Monster cables for good printer and telephone connections, products to protect your LAN from Internet intrusion, and products that act as intranet Web services.

The synergy of using computers with telephone systems takes many forms. On a basic level, we like the problem-solving features of the telephone connection products from Konexx. These products are deceptively simple, and they allow any user to link almost any

computer to almost any telephone system. You see a different kind of computer-plus-telephone synergy in the CompuPhone 2000 from Integrated Technology USA. This unique telephone-in-a-keyboard reduces desk clutter and uses the computer's power to handle calls.

Once people get benefits from a network they're hooked, and like it or not you've got a full-time job keeping things running. But people sitting at computers are their own worst enemies. As we pointed out in the October 21 issue ("TKO Your TCO Today"), management tools that limit what people can do to their computers and limit the amount of walking around you have to do can significantly reduce the total cost of ownership and improve the payback of computer systems. You also need troubleshooting tools, and we've found some that pack lots of power.

Planning Phase

Media Converters

1 Allied Telesyn AT-MC101, AT-MC102

Rewiring is radical surgery, which means you'll use the cables already in your walls whenever you can. However, if you are considering an upgrade from copper to fiber, for example, the lack of proper connections in your routers or hubs can significantly inflate the price. That's why we recommend the AT-MC101 and AT-MC102 fast-media converters (each \$599 list) from Allied Telesyn. These converters make the links between 100Base-TX copper and 100Base-FX fiber cables.

Allied Telesyn has products for many dif-

Net Tools

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ferent kinds of connections, but the ability to convert Fast Ethernet RJ-45 copper ports into ST or SC fiber connections is a key require-

ment in merging fiber into a copper infrastructure, which is why we thought these products indispensable toolkit components. Though we don't have a street price for these brand-new products yet, they should soon be available for around \$400.—FJD

Allied Telesyn Inc., Sunnyvale, CA; 800-424-4284; www.alliedtelesyn.com. Circle 961 on reader service card.

Network Planning and Design

2 Visio Professional 5.0

Every network toolbox needs a solid network planning and design tool at an affordable price, and Visio Professional 5.0 (\$350 street) fills that bill (for a full review, see "Charts for Nonartists" in our issue of November 4, 1997). It has plenty of power and great equipment images. Visio Professional comes with over 1,300 network and telecom shapes (including 640 manufacturer-specific shapes) and a set of wizards that can automatically analyze and diagram your corporate network or Web site and create an equipment database from the diagram. You don't even have to count the ports manually when you're done.

We also considered CANE 2.0 and Advanced Professional Design 3.0, two specialized network drawing tools (for more information, see "Mastering the Plans," Network Edition, December 16, 1997). But both of these require substantial up-front efforts and sport multi-thousand-dollar prices, so they didn't make it into our toolbox.—FJD

Visio Corp., Seattle; 800-248-4746; www.visio.com. Circle 962 on reader service card.



Surge Suppressors

➊ American Power Conversion PNET4

Protecting your network against mysterious power outages is quick and easy with the American Power Conversion PNET4 (\$70 street). This data line surge suppressor is excellent insurance against damaging power surges. The PNET4 is available for both 10/100Base-T and Token-Ring networks. When it detects more than 8 volts on any pair of wires in an unshielded twisted pair, it shunts the power to a ground. And the small box makes a neat installation package that can easily grow.

We also like APC's newest product for ISDN, ProtectNet (\$30 street). Also handy is the APC PTEL2 (\$30 street). If your incoming phone lines don't run through surge protectors on a UPS, then grab this product for full four-wire protection.—*FJD*

American Power Conversion, West Kingston, RI; 800-877-4080; www.apcc.com. Circle 963 on reader service card.

Installation Phase

Continuity Testers

➋ Mod-Tap SLT-3

You may be putting together your network toolkit on a budget, so instead of going for the OneTouch Network Assistant to fill your troubleshooting needs, consider the SLT-3 (\$110 list) from Mod-Tap. The SLT-3 is a two-piece device that tests installed cabling end to end. The master unit has four green LEDs, and the remote unit has four green and four red LEDs. The continually sequencing LED displays show opens, shorts, wiring reversals, and miswires.

Three jacks on each unit provide the ability to test standard USOC wiring sequences, as well as 568A and 568B. Though you won't be able to certify your cabling plant with the SLT-3, you can quickly troubleshoot connections to eliminate common wiring problems.—*Craig Ellison*

Mod-Tap, Harvard, MA; 800-866-3827; www.mod-tap.com. Circle 964 on reader service card.

Network Starter Kits

➌ Linksys Fast Ethernet Starter Kit

Big networks take mega planning, but you can short-circuit the process for a small network with the Linksys Fast Ethernet Starter Kit (\$245 list). This 100-Mbps networking kit

is great if you want to be the fastest kid on the block for cheap. It includes a four-port 100Base-TX stackable hub, two 10/100 network interface cards, and two 15-foot cables. In addition, you get straightforward diagrams and documentation geared toward those who have never set up a network before.

Linksys also has an outstanding Ethernet kit as well—the Linksys Network Starter Kit (\$169 list). We liked it so much that we awarded it Editors' Choice in our feature story "Network in a Box" (September 23, 1997).—*FJD*
Linksys, Irvine, CA; 714-261-1288; www.linksys.com. Circle 965 on reader service card.

Reporting Tools

➍ PC Inspector

In addition to having the means to manage your network, you'll need to fill out your toolkit with a reporting product. And what better than to get a high-quality one for free? That's why we chose Fluke's PC Inspector. To see how you like it, just go to www.fluke.com/nettools and download the product. This program aids your installation efforts by re-

porting on the tough stuff: the IP address, IP mask, domain name, mapped drives, transport protocol configuration, and client software configuration.

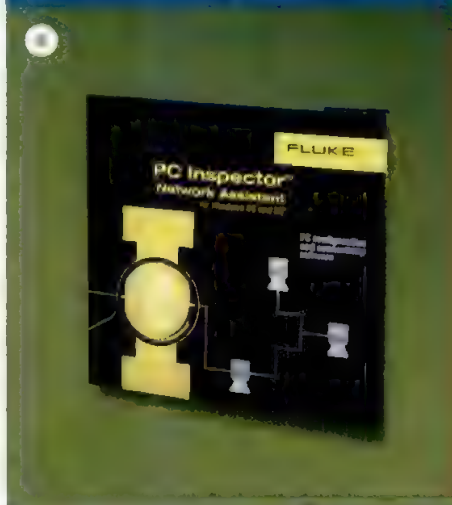
PC Inspector also reports and records all the basic information about hardware and software configuration in the PC. The program includes a nice help database with detailed troubleshooting information for IP and LAN problems. At this price, no toolbox should be without PC Inspector.—*FJD*

Fluke Corp., Everett, WA; 800-443-5853; www.fluke.com. Circle 966 on reader service card.

Troubleshooting Tools

➎ Fluke OneTouch Network Assistant

For installing and troubleshooting Ethernet networks, the OneTouch Network Assistant from Fluke is a single tool that can do it all. Though one of the more expensive items in our toolbox at \$3,695 for the 10-Mbps model and \$4,995 for the 10/100-Mbps model, this hand-held diagnostic tool is top-notch.



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The unit is equipped with a touch-sensitive, icon-based screen. A simple touch to the auto-test icon verifies desktop-to-hub connectivity, identifies cabling problems such as shorts, opens, and split pairs, and identifies NetWare, Windows NT, and NetBIOS servers. It also automatically identifies the attached subnet and the local IP router. Technicians troubleshooting IP connectivity problems will especially like the built-in ICMP Ping test. And making it easy on the eye, all results are graphically displayed to provide an intuitive view of the local network.—CE

Fluke Corp., Everett, WA; 800-443-5853; www.fluke.com. Circle 966 on reader service card.

Usage

Computer Phones

8 Integrated Technology CompuPhone 2000

While keyboard switches can eliminate clutter in the server room, our toolbox designee for doing so on your users' desktops is the CompuPhone 2000 (\$124.95 list) from Integrated Technology USA. This is the kind of tool that makes you a hero—the device combines a single-line telephone with a PC keyboard. The keypad controls the telephone, and a headset supplied with the unit plugs into the keyboard. The telephone controls include volume and mute. And the beauty of the whole deal is that you don't need to dedicate room on your desk for a phone.

The CompuPhone 2000's companion software records the time, date, phone number, and duration of outgoing calls, and it includes an automatic dialer. The phone can integrate with some PBX systems, though you might have to do some custom programming.—FJD
Integrated Technology USA Inc., Teaneck, NJ; 800-393-8889; www.ITI2000.com. Circle 967 on reader service card.

Couplers

9 Konexx Koupler

Befriending your road warriors isn't always an easy job, but with a few Konexx Kouplers in your toolkit, you may earn some new allies. The Konexx Koupler (\$149 list) can make a data connection through practically any telephone handset. It straps onto the handset of any pay or private telephone and provides an analog data connection at up to 26 Kbps.

The Koupler is about the size of a handset, so it's a little bulky but not much heavier than its internal 9-volt battery. The coiled

phone cord plugs into any modem or fax machine, but you might need a RJ-11 jack to connect to a PC Card modem. Though inexpensive, this product will reward you handsomely when your users can make connections from any phone anywhere.

Konexx Unlimited Systems Corp. Inc., San Diego; 800-275-6354; www.konexx.com. Circle 968 on reader service card.

Low-End Firewalls

10 The Wall

You have to match the tool to the job, and many smaller networks need a hearty firewall that won't break the bank, which is why our toolbox includes The Wall, from Raptor Systems ("Firewalls Made Friendly, *PC Magazine*, Network Edition, June 10, 1997). The Wall runs on Windows NT Server or NT Workstation and features a reasonable retail price (\$995 list) and extremely easy installation.

In addition, The Wall has powerful logging capabilities, so you can figure out if someone has tried to crack your network. You also get Raptor's WebNOT utility, which blocks 15,000 unsavory Web sites, and for a nominal fee, the vendor will provide periodic updates. The Wall can only be implemented on a 25-user network and is limited in its configuration options, but we feel that for price and user-friendliness, it can't be beaten.—FJD

Raptor Systems Inc., Waltham, MA; 800-932-4536; www.raptor.com. Circle 969 on reader service card.

Mini Firewalls

11 Computer Peripheral Systems Basic Mini Firewall

Bang for the buck is a constant theme here, and you can't do much better on that front than the Basic Mini Firewall (\$85 list), from Computer Peripheral Systems (reviewed in "No-Frills

Firewalls," *PC Magazine*, Network Edition, October 7, 1997). If you have a dial-up Internet connection at the desktop and are concerned about security breaches, this product is an essential toolkit component.

The Basic Mini Firewall is tiny enough to slip into your pocket, and it connects to your phone line and your 10Base-T LAN. The product works by breaking your connection to the LAN when you connect to the Internet via your modem. This way, your LAN is off-limits. Although the unit certainly isn't flexible (and being off the LAN can sometimes be inconvenient), you won't have any doubts about whether your internal data is endangered by your Internet connection.—FJD

Computer Peripheral Systems Inc., Atlanta; 800-888-0051; www.cpscom.com. Circle 970 on reader service card.

Monster Cables

12 Monster DataSpeed 350

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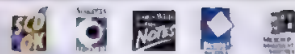
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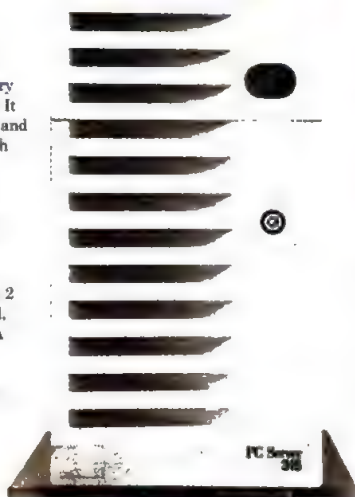
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Net Tools

THE NET TOOLBOX

DataSpeed 350 (\$29.95 list) is a must-have item in our toolkit. In addition to being reasonably priced for a 25-foot cable, the DataSpeed 350 has significant technical specifications. Like all the networking products from Monster Cable, the unit rejects outside noise and has a transmission signal that far exceeds the Category 5 cable specification.

As if this weren't enough, the DataSpeed 350 is aesthetically impressive as well. Each cable comes with a set of multicolored jackets for RJ-45 plugs, so you can color-code your connections. And the connections are, of course, gold-plated.—FJD

Monster Cable Products Inc., South San Francisco; 650-871-6000; www.monstercable.com. Circle 971 on reader service card.

Network Cameras

13 Axis 200 Web Camera

Do you ever wonder if your office is getting an uninvited midnight visitor? You can answer this question with the Axis 200 Web Camera (\$995 list). It's a standalone device that takes full-color snapshots you can view using any browser. Setup is easy, and you can place the small camera anywhere you want; all you need is power and a network connection. If you don't have a connection in your desired location, you can use the camera's built-in serial port to connect the product to a modem or other serial communication device.

Since the unit works with the TCP/IP protocol and any browser, you can easily

share your snapshots with another office via the Internet or corporate intranet. You can also save your images in a common JPEG

format.—Steve Rigney

Axis Communications Inc., Woburn, MA; 800-444-2947; www.axis.com. Circle 972 on reader service card.

Support

Keyboard Switches

14 Rose UltraView

A random stack of servers with monitors sitting on shelves is a cry for help in the server room, but the fix is easy—the Rose UltraView. This is the best tool we know to help you bring things together. It's an automated switch that moves a single keyboard, monitor, and mouse between different servers. With the touch of a button, you can link to different videoboard, keyboards, modes, plugs, and connectors. And the best news of all: An UltraView system for eight servers retails for a list price of only \$995.

The UltraView can work for a combination of Intel-based, DEC Alpha, HP 9000, Sun, Silicon Graphics, and Apple systems, among others. In addition, it generates on-screen identification and configuration information for each CPU. You can select the active system from the on-screen display or from a keyboard on the front of the box.—FJD

Rose Electronics, Houston; 800-333-9343; www.rosel.com. Circle 973 on reader service card.

Network Management

15 CyberManage

If you've got a network, you've got to manage it, which is why we include Wipro's CyberManage ("SNMP Info from Anywhere," *PC Magazine*, December 2, 1997, page 329) in our toolbox. CyberManage is an SNMP-based management system that uses a central server to display network management information in any Java-capable browser on the network. And at a list price of \$399, this Simple Network Management Protocol (SNMP) product is a bargain. Available only online, you can also download

an evaluation copy.

CyberManage runs on Microsoft Windows 95 or Windows NT, but you'll need to download and install the Java Developers Kit before you can get the product up and running. CyberManage is completely Java- and HTTP-based.—FJD

Wipro Ltd., Cupertino, CA; 408-342-0641; cybermanage.wipro.com. Circle 974 on reader service card.

Protocol Analyzers

16 Precision Guesswork PocketWatch

We all know that the best tool for digging into the sources of a network's problems is a protocol analyzer—hence our choice of the PocketWatch, from Precision Guesswork, for our toolbox. The PocketWatch (\$1,495 list; without HP 200LX, \$845) comes inside a HP 200 LX Palmtop PC with an Ethernet connection. Like other products of its ilk, the PocketWatch captures packets, strips them apart, and gives you an English language version of their contents.

The system has limited storage, so it can't grab and analyze hours of network traffic, but it is handy for solving specific problems. The software can decode all of the common transport and network protocols and most of the TCP/IP protocols, and it has lots of triggers you can use to grab just the right packets.—FJD

Precision Guesswork, Topsfield, MA; 978-887-6570; www.guesswork.com. Circle 975 on reader service card.

Remote Power Control

17 APC MasterSwitch

Despite fault-tolerant operating systems and redundant hardware, you sometimes need just to shut the whole thing down and start over. That makes the APC MasterSwitch, from American Power Conversion (\$699 list), an integral part of our toolkit. With the MasterSwitch, you can power, depower, or reboot equipment from anywhere on your network via any Web browser or any network management station. The product holds eight AC power plugs, and it's great for resetting hung modems, routers, and other equipment.

In addition, you can assign an IP address to the MasterSwitch through BootP or by connecting to the serial port with a terminal emulator. After it has an identity, the MasterSwitch responds to SNMP commands, as well as to those sent through a browser or to the serial port.—FJD

American Power Conversion, West Kingston, RI; 800-877-4080; www.apcc.com. Circle 963 on reader service card. PC



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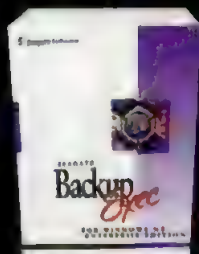
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Net Tools

FROM THE BENCH

NOS EXTENSIONS

Proxy Moxie and More

By Steve Rigney

Riding the hot wave of consolidation, Microsoft and Novell are racing to bring you "everything but the kitchen sink" network solutions. Both Novell's BorderManager and Microsoft Proxy Server, Version 2.0, put forward equal challenges to makers of standalone firewalls, proxy servers, and VPN products.

Best described as a superset of IntranetWare, BorderManager bundles many services that are included with IntranetWare as well as a user license of InternetWare, and it offers new firewall, proxy server, and VPN capabilities. As for additional compelling features, BorderManager supports network address translation and provides key-based encryption for setting up a VPN. It is also integrated with NDS. So if you have a NetWare-centric organization, are familiar with the OS, and don't mind paying a little extra, BorderManager is probably a better choice than Proxy Server.

Proxy Server, on the other hand, also provides gateway, firewall, and proxy capabilities; and via Windows NT, VPN functionality as well. As an add-on to Windows NT Server, it is nearly as complete as BorderManager. In addition, Proxy Server is much less expensive and far easier to install. And it, too, has some unique capabilities. For hierarchical caching, Microsoft has developed its own Cache Array Routing Protocol (CARP), which allows cascaded multiple proxy servers to communicate. Another component of Proxy Server is distributed caching, which allows load balanc-

ing between multiple proxy servers. Proxy Server also offers more beefed-up reverse proxying than BorderManager. One catch: You need a copy of Windows NT Server to operate Proxy Server.

BorderManager

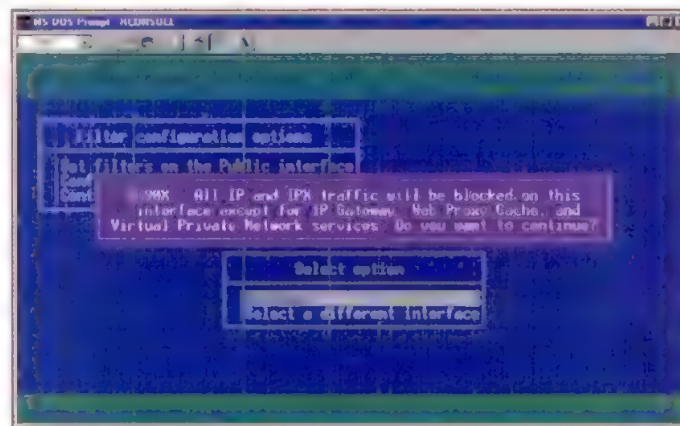
In the fall of 1996, Novell unveiled its long-awaited IntranetWare (for more details, see "Two NOSs for the Net" in our issue of July 1997), an updated version of the venerable operating system NetWare and the company's belated attempt to ride the Internet rocket. With the release of BorderManager (\$3,995 for a 25-user license), Novell has filled the Internet service and security holes in IntranetWare. But BorderManager still requires the head, heart, and soul of a dedicated NetWare master, which when coupled with the price may limit its appeal.

BorderManager includes a firewall, an IP/IPX gateway, a proxy server, a multiprotocol router, a remote-access server, VPN capabilities, MicroSystems' Web-based blocking utility CyberPatrol, and a two-user license of IntranetWare 4.11. We looked at the firewall, proxy server, and VPN capabilities, which are the truly new components. The other services are part of IntranetWare.

These services are a wonderful addition, but what makes BorderManager truly unique is

uct, you have to set up and manage each proxy server and location separately.

Installing BorderManager took us several hours. We found it a little backward and confusing, even after reading the online documentation. (Proxy Server proved much less cumbersome.) BorderManager, which consists of 4 CDs, requires a hefty 0.5GB of disk space just for installation, and the caching services may require more. Typically, you might want to install BorderManager on its own server for operation, security,



NO MORE BORDER WARS: Novell's BorderManager adds several useful features to an IntranetWare network to keep network borders under control.

its integration with Novell Directory Services. All the services in BorderManager are controlled using snap-ins to NDS, and you can manage all your users and services in the same tree. With the Microsoft prod-

and convenience reasons.

We also wanted to use a modem to administer the IntranetWare server remotely, but this wasn't explained in the documentation. With a hint from a Novell technician, we found the instructions for this task on the vendor's Web page. But if you don't complete the steps in the proper order, you may have to start all over.

One of the biggest selling points of BorderManager may be its firewall, which supports packet filtering, circuit gateway, and application proxy filtering. We didn't have any trouble getting these features to work, but we did find them easier to use in Proxy Server, as the latter provides several predefined rules and filters. Also, the BorderManager application proxy feature works only with HTTP, but support for FTP, SMTP, POP3, RealAudio, and NNTP are com-

SUMMARY OF FEATURES

NOS Extensions

	BorderManager	Microsoft Proxy Server 2.0
■ YES ■ NO		
Caching proxy server		
Web/reverse-Web/hierarchical caching	■ ■ ■	■ ■ ■
Firewall		
Packet-filtering/circuit gateway applications	■ ■	■ ■
HTTP-based applications	■	■
Network address translation (NAT)	■	
Virtual private networks (VPNs)		
PPTP tunneling/Proprietary solution	■ ■	■ ■
Multiprotocol router		
IP/IPX/AppleTalk	■ ■ ■ ■	■ ■ ■ ■
IPX-to-IP gateway	■	■
Remote access server (RAS)	■	■
Web content management	■	■

(1) Using Windows NT Server 4.0. (2) Using IntranetWare

ing. We did find that you can use the application proxy to access FTP and Gopher sites through your browser. It will not, however, natively pass these services. Unlike the case with Proxy Server, the BorderManager firewall also provides network address translation (NAT) service.

Again, though not as easy to use as Microsoft Proxy Server, BorderManager's proxy server provides hierarchical Web caching using the Internet Cache Protocol (ICP), and reverse proxy caching, which lets you cache an internal Web site on the proxy server so outside users can access its information without accessing your network. But unlike Proxy Server, BorderManager's proxy server caches only HTTP.

The open ICP standard is analogous to Proxy Server's CARP. Hierarchical caching means that

Net Tools

FROM THE BENCH

when you request an HTML document, the client will search all the BorderManager proxy server arrays to see if the document is already cached before heading out to the Internet. We found, however, that Proxy Server's implementation is stronger because it also performs load balancing among the proxy servers.

As for VPN capabilities, BorderManager provides more power than Proxy Server. Its bundled remote-access server, NetWare Connect, will support PPTP, but Novell has also developed its own key-based encryption, which is inherently more secure. The key-based encryption works only between two Net-

Ware Connect servers, however.—SR'

BorderManager. List price: For 25 users, \$3,995. Novell Inc., Orem, UT; 801-222-6000; www.novell.com. Circle 955 on reader service card.

Microsoft Proxy Server

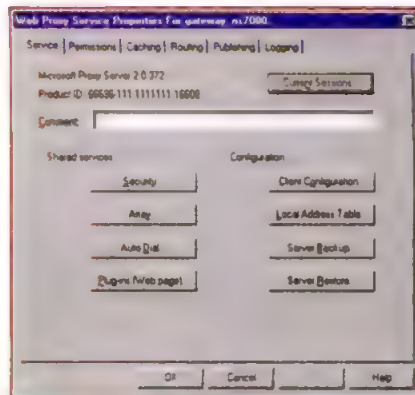
Since our review of Microsoft Proxy Server 1.0 six months ago ("Fast Pages," August 1997), Microsoft has been busily beefing up Version 2.0 (\$995 list per server, with unlimited user licenses). Though still saddled with the *proxy server* label, Microsoft Proxy Server now provides firewall and VPN capabilities as well as an IP/IPX gateway. Other new features include event logging (which is stored in the Windows NT log file), dynamic packet filtering, distributed caching, and hierarchical caching via Microsoft's Cache Array Routing Protocol (CARP).

The product is less expensive initially than BorderManager, but you do need to invest in a copy of Windows NT Server 4.0 to use the Proxy Server. And though it is true that you don't get the remote-access server or routing capability that comes with BorderManager, both features are built into Windows NT. Where Proxy Server can't hold its own against BorderManager is in management. Proxy Server includes a single graphical utility for managing the proxy server and packet-filtering rules for the firewall capabilities. But unlike with BorderManager, you can't do multiserver or remote management. Microsoft says that a free Web-based management utility will be available by the time you read this.

Installing and setting up the Microsoft product took us about 30 minutes—compared with the few hours we spent on BorderManager. If you know how to

configure two network interface cards and set up IP addresses and DNS information, you're set. The installation program comes with Microsoft's signature graphical interface and installation wizards. And compared with BorderManager, Proxy Server was impressively easy to configure and use a modem as the external interface. We set up a dial-up connection to our ISP and configured Proxy Server to make a call any time a user requested an IP address not on the local LAN. We were also able to configure how long the modem stayed connected to the ISP when there was no activity.

Like Novell's BorderManager, Microsoft's Proxy Server includes packet filtering, circuit gateway, and application-level firewall capabilities. Proxy Server puts a new twist on packet filtering, however, with its dynamic packet filtering. Traditional static packet filtering either allows or denies access to a specific destination address or port. But dynamic packet filtering denies all destinations, sources, and ports until a certified user tries to access them, and then it



MICROSOFT PROXY SERVER'S separate menus let you configure individual services.

checks the permissions allowed. This is great for services such as RealAudio, for example. A RealAudio site requires only a single IP address, but it can open multiple ports. Static packet filtering leaves all ports open for RealAudio all the time, but dynamic packet filtering opens the necessary ports when the request is made and closes them when the

BENCHMARK TESTS

Scantastic Performance



Leveraging the experience gained from our recent firewall story ("Safety from the Net," November 18, 1997), we hammered on the security portions of Novell's BorderManager and Microsoft Proxy Server 2.0.

Our test-bed emulated a typical firewall deployment in which internal users are allowed access to several network services. We configured both products so that HTTP, FTP, and RealAudio were allowed, then used Internet Security System's Internet Scanner 4.3 to attack the firewall from the external network.

As far as Internet Scanner was concerned, BorderManager rendered the network invisible to the outside world. We enabled Internet Connection Management Protocol traffic through BorderManager, which let external clients ping its interfaces, but Internet Scanner was still stumped. As an alternative, we used a shareware program called Asmodeous to scan for open ports. It too failed to turn up anything. We discovered that BorderManager cannot honor any requests if it is also using network address translation (NAT).

Internet Scanner was slightly more successful at tripping up Microsoft Proxy Server, but the few security holes were repairable. To fix some of them, we downloaded patches from Microsoft's Web site. Internet Scanner and Asmodeous determined the network services running on Proxy Server successfully.

—Analysis written by Kevin Young

CROSS

TALK



Frank Derfner

Leon, life is getting easier for network managers and tougher for companies like Cisco. Novell's BorderManager and Microsoft Proxy Server 2.0 are "add hardware and stir" solutions to tough networking problems. The prices are right, and the quality is high.

Instant cake mixes didn't put bakeries out of business, Frank. Buying a dedicated hardware system avoids the tricky integration of adapters and provides a single button fast reset. Instant software is fine if you like to tinker or need to cut costs, but the off-the-shelf approach reduces stress.



Leon Erlanger

connection is terminated. We were impressed with how easy it is to set up firewall rules, especially with Proxy Server's predefined filters, such as "deny all RealAudio requests."

Proxy Server is named after one of its strongest features. Like BorderManager, Proxy Server provides Web, hierarchical, and reverse caching. But unlike BorderManager, Proxy Server uses its own protocol, CARP, for hierarchical caching. Like ICP, CARP lets you connect multiple proxy servers so they can share their cache information. CARP can perform distributed caching or intelligent load balancing among the servers. For example, you can configure a proxy server running on fast hardware to handle more of the cache requests than a slower server. We used the feature to distribute the load evenly among PCs running Proxy Server.

Another of Proxy Server's features that BorderManager lacks is the server proxy function for reverse proxying. BorderManager lets you only reverse-proxy an HTTP Web server, whereas Microsoft's server proxy function lets you do the same with servers providing other network services, such as FTP.

For VPN capabilities, Proxy Server relies on Windows NT's RAS and the Point-to-Point Tunneling Protocol (PPTP). Security is provided using Windows NT RAS user names and passwords. We have to give BorderManager bonus points in this area. Although BorderManager works with PPTP, it includes proprietary encryption keys as well.—**SR**
Microsoft Proxy Server, Version 2.0. List price: \$995 per server. Microsoft Corp., Redmond, WA; 206-882-8080; www.microsoft.com. Circle 956 on reader service card.

MINI WEB SERVERS

Little Web Wonders

By Jeffrey G. Witt

If you're feeling the squeeze from upper management to develop your company's intranet strategy and are being bombarded by users with requests for internal Web applications, then plug in either the Compact Devices Twister Intranet Server or the MicroTest-WebZerver. Each of these Web server products is part of the latest

wave of diminutive network devices that require only a network connection, an IP address, and power. Although these Web servers are as compact as a couple of stacked-up VHS tapes, the potential of these products is large.

These mini Web servers take the network appliance approach and combine the operating system, Internet protocols, Web au-

thoring tools, processor, disk storage, and network interface into one box. Benefits of their solitary purpose and uncomplicated design are low integration, easy installation, and administrative cost savings.

For small workgroups or remote sites that need to create and post static Web pages, we recommend either of these products. Of the two, the WebZerver is a little more expensive but offers twice the storage as well as a Fast Ethernet connection and backup scheme. It also supports 50 simultaneous connections per second as compared with the Twister's 20, which is still nothing to sneeze at.

Compact Devices Twister Intranet Server

Spinning up your Intranet Web site with the Compact Devices Twister Intranet Server (\$1,295 list) couldn't be easier. This HTTP 1.1-compliant Web server, which is geared primarily toward workgroups, contains a comprehensive array of setup, file-transfer, content creation, and search tools that will please implementers as well as users. Easy HTML forms-based management handles local server tasks, while an SNMP agent allows the Twister to fall under the watchful eye of those doing centralized monitoring, a feature the WebZerver does not include. As with the WebZerver, server storage is expandable, but the Twister supports 20 connections per second versus the WebZerver's 50.

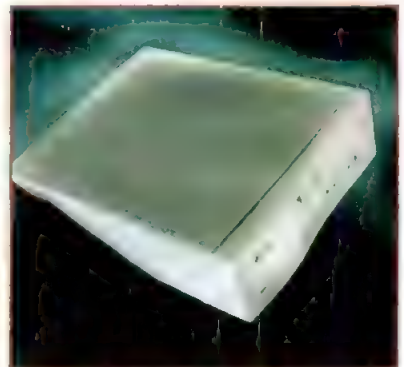
We had no difficulty firing up the Twister from our Windows 95 client; in less than 30 minutes our first custom page was ready. We ran the Windows 95- and Windows NT-compatible utility Instant IP, which requires merely entering the Ethernet address found on the bottom of the box, along with its IP address. The company provides such capabilities through BootP and RARP as well, or you can attach a client via

the provided serial port and use good old console commands.

After we entered the IP address in our browser Netscape Navigator 3.0, we were spirited directly to the server's Setup Wizard to configure the Twister's basic settings. The Wizard walks you through assigning the server name, the administrator's e-mail address, and security passwords. You can set the server as either *secure* (only supervisors can post content) or *unsecured* (all users have read/write access).

You enter users and groups or customize the look of your home page during setup or later from the point-and-click menus. We built our Web site using the simple pull-down menus, which offer buttons, bullets, background colors, images, and fill-in-the-blanks hyperlink additions.

Like the WebZerver, the Twister includes several sample sites for sales, engineering, and the like that can be easily modified. We used the convenient



BLOWN AWAY: Twister Intranet Server is a mini Web server for workgroups.

HTML utility for setting the starting point of our site by creating a document root and then using the included URL mapping.

The Twister also comes with Claris's Home Page for HTML authoring and Net-It Software's Net-It-Now for previewing and posting content. We found Net-It-Now particularly useful for formatting and manipulating existing documents and spreadsheets. An FTP option moves your polished pages to the server. Compact Devices' own FTP software File Mover lets you do the same. File

Mover is currently your best bet for backing up the Twister. Unlike the WebZerver, the Twister does not have a specific scheme for moving data to a safe location.

The Twister's proprietary multitasking operating system is ROM-based for easy uploads of future updates and includes CD-ROM ISO 9660 and read/write FAT file systems. Storage is handled by its internal 1.2GB disk, which has only half the capacity of the Web-



SMALL BOX, BIG JOB: The WebZerver can support 50 concurrent users.

Zerver. Additional media can be daisy-chained off the external SCSI-2 Centronics connector.

Physically, the Twister is slightly larger than the WebZerver but doesn't require the external power supply that ships with the MicroTest device. Labeled LEDs provide power, network, and system status as well as network and disk drive activity. The RJ-45 connector provides network connectivity for 10-Mbps Ethernet but doesn't have the 100-Mbps capability of the WebZerver. To connect to coax-based Ethernet setups for an additional \$100, you can order a BNC converter kit from Compact Devices.—JGW
Compact Devices Twister Intranet Server. List price: \$1,295. Compact Devices Inc., Campbell, CA; 800-894-0519; www.devices.com. Circle 951 on reader service card.

MicroTest WebZerver

Effortlessness and simplicity define the MicroTest WebZerver (\$1,595 list). Aimed squarely at the workgroup, this little box of-

fers big features, such as a Fast Ethernet connection and a backup scheme, that set it apart from the Twister. And the WebZerver's elegant, uncomplicated collection of utilities will make even the most inexperienced user comfortable. The device offers rapid setup and, like the Twister, is amply stocked with Web site construction and management tools. Able to accommodate 7 additional SCSI devices for storage and up to 50 concurrent connections, the WebZerver will satisfy the demands of any new intranet launch. The Twister also lets you hang up to 7 devices from it but supports only 20 simultaneous connections.

Starting up the WebZerver was straightforward: We were working on our site within 10 minutes and ran through the complete design in about 30, just as we did with the Twister. Several configuration methods are avail-

able. The server first attempts to use its Auto IP method by having you type the factory-assigned NetBIOS name that the network should resolve into your browser. This didn't work for us, as we weren't running the required DHCP protocol on our test network. Instead, we used the EasyIP method. We were assigned a temporary IP address that got us to the configuration page by way of our browser Netscape Navigator 3.0. Additional configuration options let you use BootP and RARP.

Easy, MicroTest's aptly named utility suite, guides you through site construction and operation. EasySite presents you with a scripted installation, in which you enter administration names, passwords, and user and group accounts. You can leave the site open to all users or secure the server by directory, user, group, and read/write access. One glitch we found is that user passwords don't work until entered a second time. MicroTest is working to resolve this.

MicroTest WebZerver accom-

Net Tools FROM THE BENCH

modates backups, a feature missing from the Twister, by supporting Microsoft's Server Message Block protocol. You merely map a drive to the WebZerver and use any compatible Microsoft networking backup software.

Like the Twister, the WebZerver offers you sample site layouts for departments such as human resources, tech support, and marketing. You can easily insert hyper-links to other sites and add folders to the current page. EasyTalk, a feature we'd like to see in the Twister, lets you add discussion rooms or groups similar to those found in threaded newsgroup services.

We used the EasyStyle software to dress up our Web pages by inserting images, adding text, and changing colors and backgrounds. To remove the complexities of posting content and the need for an administrator, EasyPrint installs on desktop applications and lets you direct your document to

the WebZerver. The output goes to the server and not the printer. We moved several Microsoft Word documents directly to the WebZerver without hassle. Also included are NetObjects Fusion for HTML editing, Ipswitch's WS-FTP for file transfer, and Microsoft's Explorer 3.0 for browsing. Rounding out the utilities are EasySubmit for posting content in its native form and EasySearch for quick searches in your Web page.

Under the WebZerver's hood, you'll find the embedded operating system with an HTTP 1.1 Web server that, like the Twister, has system upgrade capabilities. The file system handles read/write VFAT, DVD-ROM, and CD-ROM ISO-9660 standards. The WebZerver requires the use of an external power supply (a standard power cord that ships with the Twister). A couple of the Twister's minor features that we'd like to see on WebZerver are labeled LEDs and an on/off power switch.—JGW

MicroTest WebZerver. List price: \$1,595. MicroTest Inc., Phoenix; 800-526-9675; www.zerver.com. Circle 952 on reader service card.

CD-ROM SERVERS

Sharing the Wealth

By Steve Rigney

Having to install new applications for your users from a single CD is one of the most common curses of networking. The time-consuming task involves walking from desktop to desktop with the CD and sometimes even a portable CD-ROM drive. Sharing one information-pack CD among users is also an issue. Though network CD-ROM solutions have been on the market for a while, they usually require a specific NOS and special client software to access the servers. Two products, the HP CD-ROM Server and Realm Universal Server, put a fresh spin on this market.

These two standalone CD-ROM servers work with almost any client, and neither requires

server- or client-side software. Each handles a multitude of CDs without needing to be connected to an existing file server. In addition, each product includes a Web-based management utility. The products do have some differences, however. The Universal Server comes in a large chassis and can handle up to 255 CD-ROMs. The HP CD-ROM Server can handle far fewer CD-ROMs but is much less expensive. The HP product also works with Unix clients and offers better user security.

Both products are undeniably sturdy, but the Universal Server is definitely designed to handle more users. On the other hand, the CD-ROM Server works with a larger variety of clients and offers better management features.

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HP CD-ROM Server

Though a fancy name doesn't adorn the outside of the new HP CD-ROM Server, this product supports almost every flavor of Windows, NetWare, Unix, OS/2, and—unlike the Universal Server—NFS clients. Appropriate for



GENERIC IN NAME ONLY: The HP CD-ROM Server is a snap to manage.

both enterprise-level and smaller networks, the CD-ROM Server also includes Web-based management, giving you the freedom to manage from any location. We tested the chassis model (\$4,140 list), which houses the server and 7 external CD-ROM drives. The standalone CD-ROM Server (\$695 list) is a box that handles up to 14 external drives.

As for security, the CD-ROM Server is more powerful than the Universal Server—except in the area of setting user inactivity limits. But the real difference between the two lies in the CD-ROM Server's ability to provide user-level security. The Universal Server lets you only deny or allow access to a CD to all network users.

Another strength the CD-ROM Server has over the Universal Server is its logging capabilities. The event and statistics logs show how many users are connected, the types of network clients they are using, and how long they have been accessing a particular CD. You can also monitor the standard throughput of the CDs and the number of cache hits.

To expand the number of CDs you can offer your users, you can invest in the HP CD-ROM Tower (\$995 list), which includes eight

bays—seven for CDs and one for the server if you purchase it as a module that fits inside the tower. You can't daisy-chain the towers, however. HP also offers 20X CD-ROM drives (\$350 list) as part of the product family. For \$4,140, you can buy a complete system that includes the server, the tower, and seven 20X CD-ROM drives and will hold up to 56 CDs. Though this is far fewer CDs than the Realm product can hold, the price is also proportionately smaller.

Unlike the Universal Server, the CD-ROM Server doesn't include monitor, mouse, or keyboard connectors, since the only task you need to perform at the server is switching on the power. All configuration and management tasks are handled through the Web-based management utility and your browser. The unit lacks a hard disk: All of its software is stored in Flash ROM.

After we connected the CD-ROM Server to our network, we could go to any NetWare-, Windows-, or Unix-based client and configure the system. To access the server using a Windows or NetWare client, we simply browsed the network and the CD-ROM Server appeared. To access the server with Unix clients, we first needed to use an Address Resolution Protocol (ARP) command to configure the server's IP address. This task is well documented and works from Windows NT or Unix PCs. If you don't want to give the server a static IP address, configure it to use a BootP, DHCP, or WINS server.

With the Web-based management utility, all we did was enter the IP address of the server in our Web browser to perform the configuration tasks. But unlike the Universal Server, the CD-ROM Server also comes with an SNMP agent.—SR

HP CD-ROM Server. List price: Tested configuration, \$4,140. Hewlett-Packard Co., Palo Alto, CA; 800-752-0900, 415-857-1501; www.hp.com. Circle 953 on reader service card.

Net Tools

FROM THE BENCH

Realm Universal Server

In addition to being able to control up to 255 CDs using 3 dual-channel SCSI adapters and external drives, the Realm Universal Server (\$9,495 list for a 24X CD-ROM unit with 7 drives and \$12,495 for a unit with 14 drives) lets you connect SCSI media devices, such as hard disks and ZIP drives, potentially turning it into a storage device as well as a CD-ROM server. Although the Universal Server is expensive (the 7-drive unit is more than twice the price of the tested HP product), the unit's level of scalability makes it perfect for enterprise-level networks. For our tests, we looked at the 7-drive model.

This chassis includes a PC and all the software you need to share CDs with NetWare, OS/2, Windows 95, and Windows NT clients.



TALK OF THE REALM: The Universal Server can support up to 255 CD-ROMs.

(Support for NFS clients will be available by the time you read this.) In addition, we looked at a beta version of the Universal Server's Web service, which will give users access to the CDs through a browser. It, too, will be available by the time you read this. The Universal Server also spans multiple CDs across a single volume. On our tests, we spanned three CDs across a single volume and then mapped a single drive letter to the three CDs..

As with the HP unit, installing and configuring the Universal Serv-

er is a snap via the Web-based management utility. And although the Universal Server's security isn't as robust as that of the HP product, we were able to limit the number of simultaneous users who could access a CD, disconnect users after a period of inactivity, deny all access to a volume, and specify whether a CD should be accessible from a browser. You cannot set up individual users, however. You must either deny or allow access to all users on the network.

Documentation is lacking, and we couldn't get the online portion working at all until we were assisted by a company engineer. Also, the product lacks logging, reporting, and notification features.

A big box, the Universal Server includes a Pentium/133 processor running Linux, 64 MB of RAM, a 2.1GB hard disk, an Adaptec dual-channel SCSI controller, and bays for 7 or 14 CD-ROM drives or other SCSI storage devices. When we first turned the unit on, we saw

several somewhat intimidating Linux commands flashing across the screen. But after that, we were presented with a simple eight-option configuration menu. To manage the server remotely, we logged into the server and configured the network adapter with the proper TCP/IP information. Then we could go to any PC with a browser to finish setting up the server.

We found the Web-based management utility WebAdmin easy to use.

The first screen showed us all the drives that were installed. By clicking on each one, we saw the contents of each CD. Other tasks we performed from the management utility included setting up the server, adding new CDs and devices, and changing the server's password.—SR

Realm Universal Server. List price: Tested configuration, \$9,495. Realm Information Technologies, Norcross, GA; 770-446-1332; www.realminfo.com. Circle 954 on reader service card. PC

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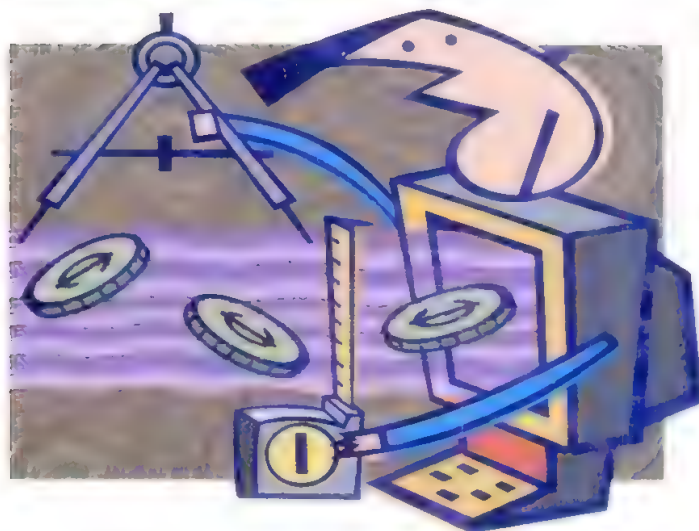
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IP MULTICAST

Bandwidth on a Budget



By Robert P. Lipschutz

Running multimedia over the Internet has been a hot topic over the last few years. New applications such as videoconferencing, videocasting, online concerts, and computer-based training promise to bring people together in new ways—but each of these applications requires either *mucho* bandwidth or a guarantee of no delay in passage. Additional bandwidth and higher-quality service mean higher cost, so savvy network planners want ways to reduce costs while improving service. One way to do so is by using IP multicast.

Defined by an IETF RFC, the IP multicast standard describes ways to broadcast efficiently over existing bandwidth. For example, to broadcast video from a site in San Francisco to five users in New York, you generally have to send out five separate video streams. IP multicast defines a way to reach the same five users by sending only a single stream to a

router in New York with multicast capabilities. This router then directs a separate stream to each recipient. In this configuration, IP multicast reduces the bandwidth needed for the expensive long-distance portion of the route: The more recipients at the other end, the greater the savings.

HOW IT WORKS

Multicasting was defined in its current form in 1989 when Steve

Deering at Stanford University authored RFC-1112, titled *Host Extensions for IP Multicasting*. The first hardware and software trials started in 1992.

The basic components for IP multicast are multicast-aware applications, a Class D IP addressing scheme, and multicast routers. The Internet Group Management Protocol (IGMP) defines how the applications and routers talk to each other.

The first and largest step in using IP multicast is to obtain or develop two-part applications that can make their ways through the network. The IP multicast application sending the multimedia stream must know how to send to a single multicast address, and the receiving applications must know how to subscribe to and unsubscribe from multicast groups.

Despite the years that have gone by since RFC-1112 was published, most current multimedia applications don't use IP multicasting. Instead, products like White Pine's Enhanced CU-SeeMe, Microsoft NetMeeting, and Progressive Networks' RealMedia use traditional point-to-point connections. Essentially, these products establish a separate TCP session with each recipient account and address separate streams of packets to each recipient. IP multicasting is a more efficient method to send identical content to multiple recipients simultaneously. A multicast-aware application from a company like ICast Communications or Precept Software can

send packets to a multicast address. On the recipient's side, a client or viewer application from the same vendor knows how to subscribe to and unsubscribe from multicast groups and play incoming multimedia content. In between, multicast routers do all the travel planning.

MULTICAST ROUTERS

Routers that know how to deal with multicast packets are called *mrouters* (multicast routers). Multicast packets aim for efficiency, and these routers have to make the smart decisions.

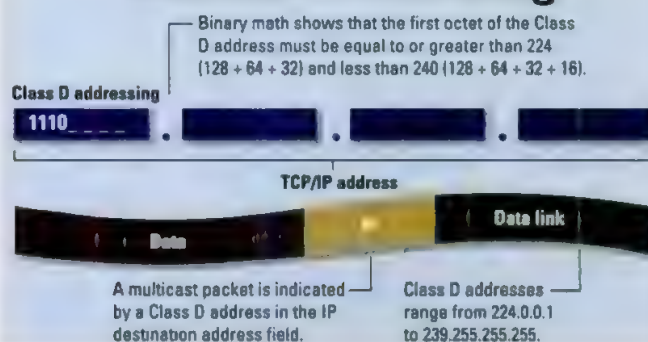
In a properly configured system, mrouters efficiently forward the packets and fan out the data into separate streams only for the last hops to the clients. An application sends packets to multicast group addresses, and mrouters make sure the packets get to all the right destinations.

The problem arises when segments of your network don't have mrouters. When a router that doesn't understand multicast receives a multicast packet, it chokes.

When two multicast routers have to communicate across a segment with one or more of their less capable cousins in between, they use *tunneling*, which encapsulates each multicast packet inside a standard IP packet using the address of the destination mrouter. The recipient mrouter breaks out the multicast packet and sends it along to the multicast destination addresses.

For IP multicast to work, routers must know the addresses of the members of each multicast group. Client-side applications are responsible for subscribing to multicast groups by sending messages to mrouters using IGMP. Mrouters talk to each other using special multicast-routing information protocols, such as Distance Vector Multicast Routing Protocol (DVMRP) or the Multicast Open Shortest Path First protocol (MOSPF). These protocols are analogous to standard routing-information protocols like RIP and OSPF.

Multicast Addressing



CLASS D ADDRESSING

We've talked a little about IP multicast addresses, but let's demystify them. IP multicast addresses are Class D, not the familiar Class C addresses that most people have. These addresses designate packets as destined for a multicast group rather than for a single recipient. A multicast address is never a source address, only a destination address.

Because IP multicasting happens at the network layer, it has nothing to do with the underlying networking layers. Therefore, it can work over diverse networks such as Ethernet, Fast Ethernet, Token-Ring, ATM, frame-relay, and T1. End users can connect over modems for audio applications but will minimally need ISDN for acceptable video quality.

THE MBONE CONNECTION

Enough about theory: Is anyone doing IP multicasting? It turns out that there is a fairly substantial Internet multicast network called the Mbone. The Mbone serves as a demonstration facility and testbed for IP multicast, and it gives access to many events sponsored

by a variety of groups and companies across the Internet.

Mbone stands for *multicast backbone* and denotes a virtual IP multicast network on top of the existing Internet backbone. The Mbone is not a separate physical backbone but is made up of all Internet routers with multicasting routing capabilities. Today, the Mbone is a collection of multicast-capable router islands separated by routers that do not understand multicast routing. The islands connect through point-to-point links called tunnels.

The Mbone followed the development path of many other Internet applications. The first applications using Mbone were available only on Unix platforms and were the domain of the gurus. PC-based applications supporting IP multicast have slowly emerged, and now most Mbone events are viewable on PCs running Windows 95 or Windows NT.

GETTING STARTED

To take advantage of IP multicasting, determine which application you want to multicast. If

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you want to feed live video broadcasts out to your employees, for example, you typically need to set up a high-quality video camera, which connects through a special adapter in your PC or your Unix workstation. A "broadcaster" application that supports IP multicast transmits out to an IP multicast group. Your audience needs the associated client software with IP multicast (and perhaps a special video codec board for better quality) to view the event.

These applications otherwise have the same general capabilities and functions as multimedia applications without IP multicast. The multicast application might use standard UDP to stream audio or video across a network, or it might use the more efficient Real Time Protocol (RTP).

The next step is to make sure you have access to an mrouter. More and more ISPs have this capability, and UUnet has been extremely vocal about the multicast capabilities of its UUCast service. You do have to pay extra for this service. Many of the

routers on the Internet do not have IP multicast support, but this is changing. The newest Cisco software supports IP multicast, but many already deployed routers do not. In fact, many of the m routers operating today are Unix workstations, such as Linux or Solaris machines, running the mrouterd daemon.

WHERE ARE WE TODAY?

In addition to high-bandwidth multimedia, IP multicast has been explored for smaller bandwidth applications with large numbers of users, such as the delivery of news or stock quotes. Given the smaller gain from IP multicast in these applications and the upfront work needed to get an intended audience on multicast, companies like Marimba and PointCast have not yet adopted an IP multicast approach. More interesting is the use of IP multicasting for large-bandwidth (but not necessarily multimedia) applications, such as software distribution or large-file transfers.

Lessons learned in LAN innovation tell us that managing bandwidth is often more expensive than simply buying more. But bandwidth is scarce on the Internet, and techniques like IP multicast have large payoffs.

Unicast vs. IP Multicast

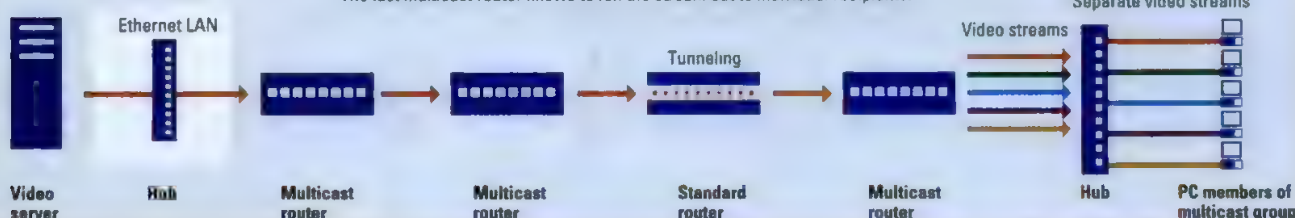
Unicast

In a unicast model, a video server has to send five separate video streams across the WAN to reach five separate users.



IP Multicast

With IP multicast, special multicast routers send only a single stream across the WAN. The stream passes through standard routers using point-to-point tunneling. The last multicast router knows to fan the stream out to individual recipients.



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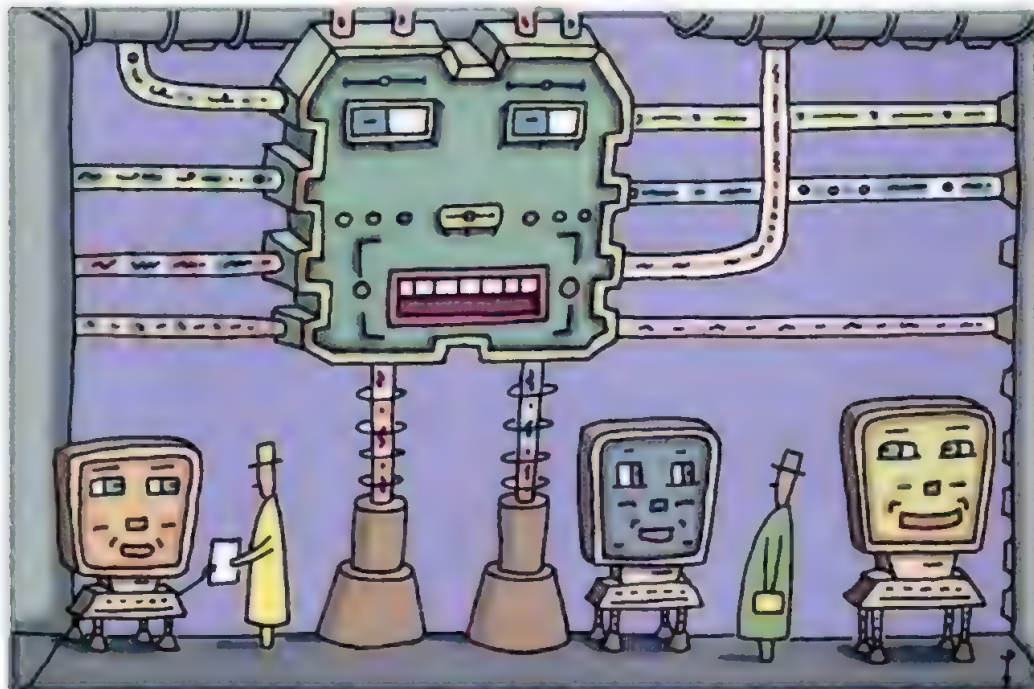


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PC Tech



Designing Distributed Applications

In software design, performance is a key issue too often misunderstood or ignored by developers.

By Chris Loosley

At first the personal computer was truly personal. But soon, local area network (LAN) technology let companies link their PCs together, allowing coworkers to share and exchange information. Now the formerly separate islands of LAN-based computing that have sprung up over the last ten years are being linked by public and private wide area networks (WANs) to form enterprise networks.

Business reasons are driving the move toward enterprise-wide distributed applications, despite a consensus that these systems are difficult to build and expensive to maintain. Among those reasons:

- Most modern enterprises are already distributed and need distributed information systems to support them.

- Competition creates an increased focus on the importance of customers and consequently on the information resources and services that are required to support interactions with customers.

- Companies hope to exploit the newest computing technologies to improve their business processes in order to stay competitive or become more efficient or profitable.

A common example is the goal of creating a business process that offers customers a single point of contact with an enterprise, even though a customer's business may actually require services to be provided by many different parts of the organization.

To support such a business goal requires enterprise-wide information processing, which introduces many new challenges for application

INSIDE

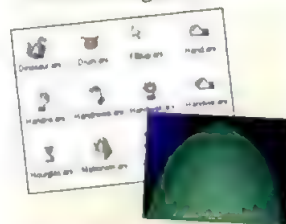
TUTOR: Talking to computers has long been a staple of science fiction movies, but voice recognition on your PC is only beginning to be possible. *Page 235.*

OPERATING SYSTEMS: DirectShow not only plays existing multimedia formats but can also incorporate support for future standards such as DVD. *Page 241.*

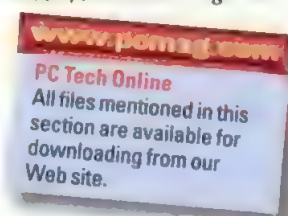


▲ INTERNET: A standard modem no longer satisfies serious Web surfers. Find out about high-bandwidth alternatives. *Page 249.*

UTILITIES: SyncURLs imports your Navigator bookmarks and Internet Explorer favorites so you can rearrange them and synchronize them between browsers. *Page 253.*



▲ PC SOLUTIONS: Let animated cursor files serve as their own icons; Windows 95's Plus! can stretch wallpaper to create amazing effects; and more. *Page 263.*



developers. Systems must be created to organize, maintain, locate, relocate, relate, summarize, and display the right data wherever it is needed, as quickly as is necessary to meet the needs of some larger business process, and in the face of ever-growing transaction volumes and databases that may span terabytes.

As yet, there is little agreement on the most suitable application architectures or design techniques to use for such systems. A major cause of uncertainty is the continuing rapid evolution of the underlying software technologies that support the growth of distributed computing:

- Database management systems (DBMSs, now commonly called *database engines*), which used to store only text and numeric data, now support a wide variety of business data formats, including graphic images, voice, and video.
- Database engines are used to manage and disseminate shared corporate information from dedicated servers such as Web servers, subject-area data marts, and corporate data warehouses.
- All leading database engines support remote access to data via gateways and distribute data updates to remote copies of databases using a variety of replication facilities.
- To operate in a distributed information environment, applications must be constructed of distributed layers, components, or objects, which communicate through *middleware*—a category of software unheard of before the 1990s.

Applications developers and the vendors of development tools that support them are affected by the pace of these changes. To meet the demand for visual programming and rapid development, tool vendors offer a bewildering array of new products, always seeming to promise out-of-the-box solutions. This creates a never-ending flood of new information in books and magazines, on the Internet, and at conferences, seminars, and trade shows. But the industry tends to devote more “mind space” to the bells and whistles of the latest products than it does to solid practical guidance on how to use them effectively to solve business problems. As a result, far too many applications are poorly designed and fall short of their users’ needs. Developers just can’t keep up.

In the process, application performance is an area of software design that is frequently misunderstood, forgotten, ignored, or postponed, often with disastrous results. Obtaining acceptable performance in the enterprise computing environment requires radically different archi-

tectures and designs from the single-server systems in a mainframe or LAN server environment.

THE MYTH OF UNLIMITED SCALABILITY

A few years ago, it was widely held by proponents of open systems and downsizing that in a distributed system performance becomes less of a design issue. The new flexible, scalable application architectures, the argument went, would let us address any performance problem simply by moving parts of the processing to faster hardware.

Actually, years of experience with high-performance transaction systems show that the opposite is true, because typically problems arise not in the individual system components

apply the locality principle. Locality is a scarce resource; those who squander it must work twice as hard to avoid adverse performance consequences. Hence the dilemma of distributed systems’ performance, because distribution is the opposite of locality.

Even within monolithic applications, separating related software components can introduce I/O delays, especially if the components are stored in separate files or databases. For example, a related block of data stored together can be retrieved as a unit, but related data split into separate tables must be joined back together—a task that performs well only if we design and build the right indexes.

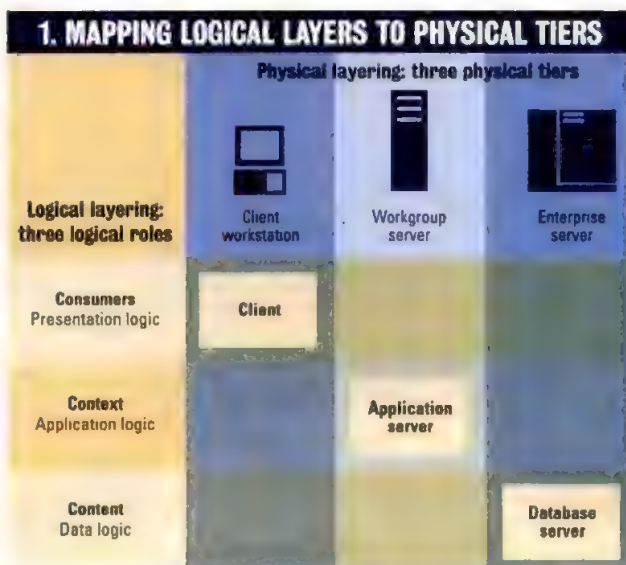
The monolithic environment can also be a forgiving one. When every module is processed by the same machine, the precise location of the module boundaries has little effect on performance, because any communication between modules happens at processor speed. The distributed environment is much less tolerant of poor design decisions. Far from enhancing performance, distributing related components among several processors introduces additional network delays.

If we could somehow record all our enterprise data and programs on a single chip and connect the chip to everyone’s desktop with fiber-optic cables, the only remaining performance worry would be bad programming algorithms. Of course, in the real world, processor capacity and network bandwidth constraints prevent a single-component solution. And once we are

forced to move away from solutions that are based on a single central copy of any application component, a key design goal is to minimize communication overhead. What’s more, the usual cause of problems is not the volume of information to be exchanged but the processing overhead and response-time delay associated with each message.

A good software design is one that creates components that “do the job, the whole job, and nothing but the job”—in technical terms, maximizing cohesion and minimizing coupling among components. When we implement such a design, a low degree of coupling is optimal, because it minimizes the level of intercomponent messaging at execution time. Distributed objects should be looked at especially carefully. Despite all the current hype about CORBA and DCOM, for distributed object technology to perform effectively, the objects must be neither too fine-grained nor too distributed.

Current implementations of distributed objects embody another significant problem,



but in the links connecting them. This is because of a fundamental fact of performance that is embodied in the locality principle, which deals with the importance of closeness. Because closer usually means faster, a core technique of performance involves bringing together components that need to be used together. There are four distinct types of locality, all of which influence performance:

- *spatial*—closeness in space, or proximity;
- *temporal*—closeness in time;
- *degree*—closeness in capacity;
- *effectual*—closeness in purpose.

The locality principle says the best performance comes when servers or resources (such as routines, files, databases, processors, memory, networks, or storage devices) are designed or configured to match the demands placed upon them by the application workload.

Locality is always crucial to performance no matter what the computing environment. The grouping techniques used in designing databases, modules, and user interfaces all

synchronous communication. We'll discuss that in a moment, but first let's look at the application design problem in a bit more detail.

LOGICAL LAYERS AND PHYSICAL COMPONENTS

Information processing applications comprise five major functional layers:

- a *presentation manager*, like Windows or OSF/Motif;
- a *presentation logic layer*, which handles the user interface;
- an *application logic layer*, sometimes called a *control logic* or *flow logic layer*, which enforces correct application behavior;
- a *data logic layer*, which stores and retrieves data using the database engine;
- a *database engine*, such as DB2, Oracle, or SQL Server.

The presentation manager and database engine are standard components. The three logic layers must be developed. The design challenge is to allocate the contents of the logic layers to the physical components. The grid in Figure 1 is a handy framework for discussing the options; it maps the three logic layers (dubbed Consumers, Context, and Content) on the vertical axis to the three physical tiers on the horizontal axis.

Conceptually simple solutions have their advocates. Unfortunately, their excessive communication overhead makes them likely to perform poorly. As Figure 2 shows, every data request requires two traversals of a pair of network links, one a relatively slow WAN.

Optimal solutions for heterogeneous distributed environments are not so simple-minded. Some examples:

- Presentation logic is, of course, centered on the client workstation, especially in traditional client/server environments. But in Web-based environments, some presentation logic also resides on the Web server on the workgroup or enterprise tier.
- Application logic and workflow management are centered on a workgroup or application server, but some aspects are handled by the client workstation, and some by the enterprise server.
- Data logic can be spread across all three tiers, with the workgroup and enterprise servers sharing most of the responsibility.

MIDDLEWARE MANAGES COMMUNICATION

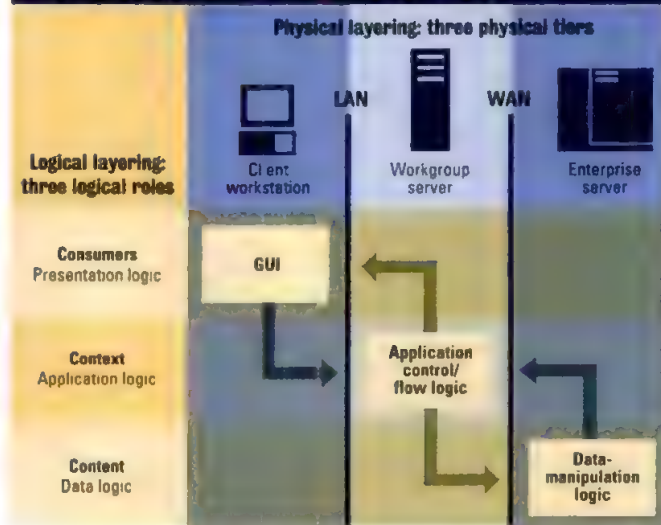
When related components are distributed in this way, a key design question is how they should communicate.

The answer is through middleware—sometimes referred to as the slash in client/server. Middleware is a vague term, but a reasonable working definition is the layers of software

that let distributed application components interact. Although middleware takes many forms, its basic function is to enable inter-process communication. Middleware products provide an application programming interface (API) that isolates the application programmer from the details of lower-level network communication formats and protocols (FAPs).

Let's look at Figure 3. We can use our grid to define three major classes of middleware,

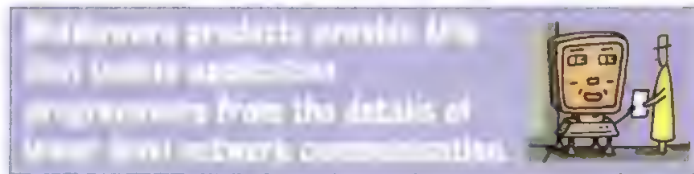
2. EXCESSIVE COMMUNICATION KILLS PERFORMANCE



which—as you can see—are named according to the kind of logic being distributed.

The most widely used example of presentation middleware is the combination of a Web browser on the client workstation, HTTP, and a Web server. Using presentation middleware leads to the style of application known as thin client, so named because only the user interface resides on the workstation.

Most two-tier client/server applications are



built using proprietary database middleware supplied by a DBMS vendor. The middleware ships SQL requests over the network to a relational DBMS and returns data to the client application. Another common example of database middleware is the database gateway, which supports remote database access to more than one database engine, using an ODBC API. Because most of the logic of such applications resides on the workstation, with only the database engine on the server, they are known as *fat clients*.

APPLICATION MIDDLEWARE

Application middleware, the most important type in building enterprise-class (three-tier) distributed applications, supports many styles of distributed logic. In approximate order of complexity, they are:

- point-to-point (P2P), or direct messaging;
- remote procedure calls (RPCs);
- message queuing (MQ)—the combination of direct messaging (P2P) and message queuing is called message-oriented middleware (MOM);

- distributed transaction monitors (DTMs);
- object request brokers (ORBs).

Application middleware differs from database and presentation middleware in a significant way. Database and presentation middleware let user-written components talk to supplied database engines or Web browsers. The developer has very little design flexibility, because the software vendor (or an industry standard like HTML or SQL) has already defined

most of the rules (the formats and protocols) for the communication.

Application middleware, in contrast, is more like a general-purpose programming language. It lets two user-written components communicate in any way that suits the application designer and developer. The choice of communication style is a key application design decision, particularly the question of whether to implement synchronous or asynchronous connections.

TO QUEUE OR NOT TO QUEUE

One of the theoretical benefits of distributed computing is the opportunity it provides to divide work among a network of independent computers, each operating at its own optimal pace.

But any server has a limited capacity to process concurrent requests, each of which consumes some amount of the server's memory and CPU resource. If we try to drive a server to a higher level of concurrency than its memory and CPU capacity permit, we actually get less done, because the overhead of memory swapping and task or context switching take up more of the processor.

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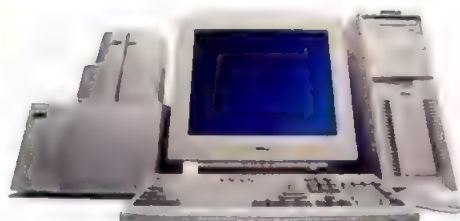
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tions keeps submitting synchronous requests at a rate higher than a server can handle, the system gets overloaded, requests get backed up, and performance spirals downward at an ever-increasing rate until the users get frustrated and go for a coffee break. When some people stop using the system, performance improves for the remainder.

To sum up, when we tie our software components together with synchronous connections, two bad things can happen:

- Peaks in demand from clients can create overload conditions at servers.
- When any one component of a distributed application waits, the delay tends to be propagated throughout the system.

No matter what the power of your processors or how many you may have, you gain nothing if they sit idle, waiting for some other component. The more diverse the enterprise and its computing environment, the more likely you are to encounter such complications. Four areas of diversity are common in enterprise computer networks:

- **Variable capacity.** Components may operate at many different speeds.
- **Variable contention.** Components operate in different processing environments, so that some may be subject to delays from sharing resources with other work.
- **Variable availability.** It is hard to ensure that independently controlled components are all available simultaneously.
- **Variable demand.** A single business transaction may place uneven demands on the components. While one portion of the work may be accomplished in seconds, another task may take minutes or even hours.

To minimize the impact of such variability on application performance, distributed designs must be based on asynchronous communication using message queues. Using queues to decouple requesters from servers smooths out peaks, allowing each server to process requests at its optimal pace in the face of variable demands. By eliminating the overhead of interruptions, queues maximize server performance and so minimize the time a requester must wait for service.

DISTRIBUTED DESIGN PATTERNS

On the strength of the design principles we have laid out (and omitting a lot of supporting arguments for reasons of space), we can reach some conclusions about the design patterns that will work best for enterprise-wide applications.

Because widely distributed users still need to share corporate information, to satisfy the demands of locality we must use caching and replication techniques to move copies of essential data closer to users.

For optimal performance, we should avoid designs that require remote or multiple-site updates within a single transaction, preferring a multiphase, asynchronous approach like the one shown in Figure 4 and described below.

Phase 1: Update. Updates are first recorded in a copy of the database at a local node. The local database copy acts as a more current cache of a master version stored centrally. If possible, the local version is a fragment of the master, containing only the subset needed for typical local operations.

Phase 2: Collect. Copies of the local updates are forwarded asynchronously to a master copy of the data at a central location. There are a variety of ways to do this—as in-

cessing style. Off-line transaction processing software is also appearing, to support mobile clients that demand a similar processing style.

MAINTAINING DATA INTEGRITY

Regardless of the technology used, distributing interrelated information across separate sites poses data integrity and consistency issues. Key design questions are:

- Is it actually possible for the same data element to be updated simultaneously at more than one location?
- When multiple-site updates are required, how and when will intersite integrity rules be enforced without using a synchronous updating protocol, like two-phase commit?

The answers always depend on the application. Full discussion of these complex issues is beyond our scope, but here are some important conclusions.

Update conflicts: Updates may be flowing concurrently in both directions in Figure 4, yet the business process often ensures that these updates relate to different data elements. Although all nodes in the network may see all the data, update authority is partitioned among the nodes, because customers may be assigned to a particular sales office or products to a particular factory or distribution center.

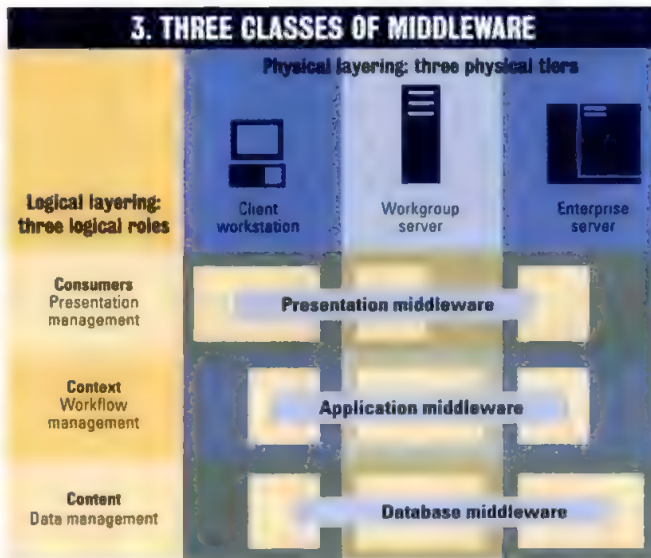
When a business uses such partitioning schemes, the information processing flow can be simplified. We do not need to create elaborate procedures to resolve potential update conflicts that can't actually occur in practice. If data can be perfectly partitioned—for example, when each region stores and uses only regional data—then

there is no need for phases 4 and 5 of Figure 4.

Intersite consistency: Although transactional messaging middleware can guarantee eventual delivery of all messages, processing is simplified and performs better if business requirements allow intersite consistency to be relaxed for short periods during updating. Even though the central master copy of data is maintained in a consistent state, local copies may be temporarily inconsistent, because of the delays in asynchronous updating.

A DISTRIBUTED DESIGN PHILOSOPHY

To sum up, when we design applications for the enterprise, a key principle is "design applications that don't wait," for two reasons. First, applications that wait make poor use of computing resources. But even more important, applications should not make users wait. When



dividual update messages, in batches, or using DBMS replication software.

Phase 3: Consolidate. Updates are posted to the master version of the data, possibly in batches, depending upon the appropriate balance of data currency and update efficiency.

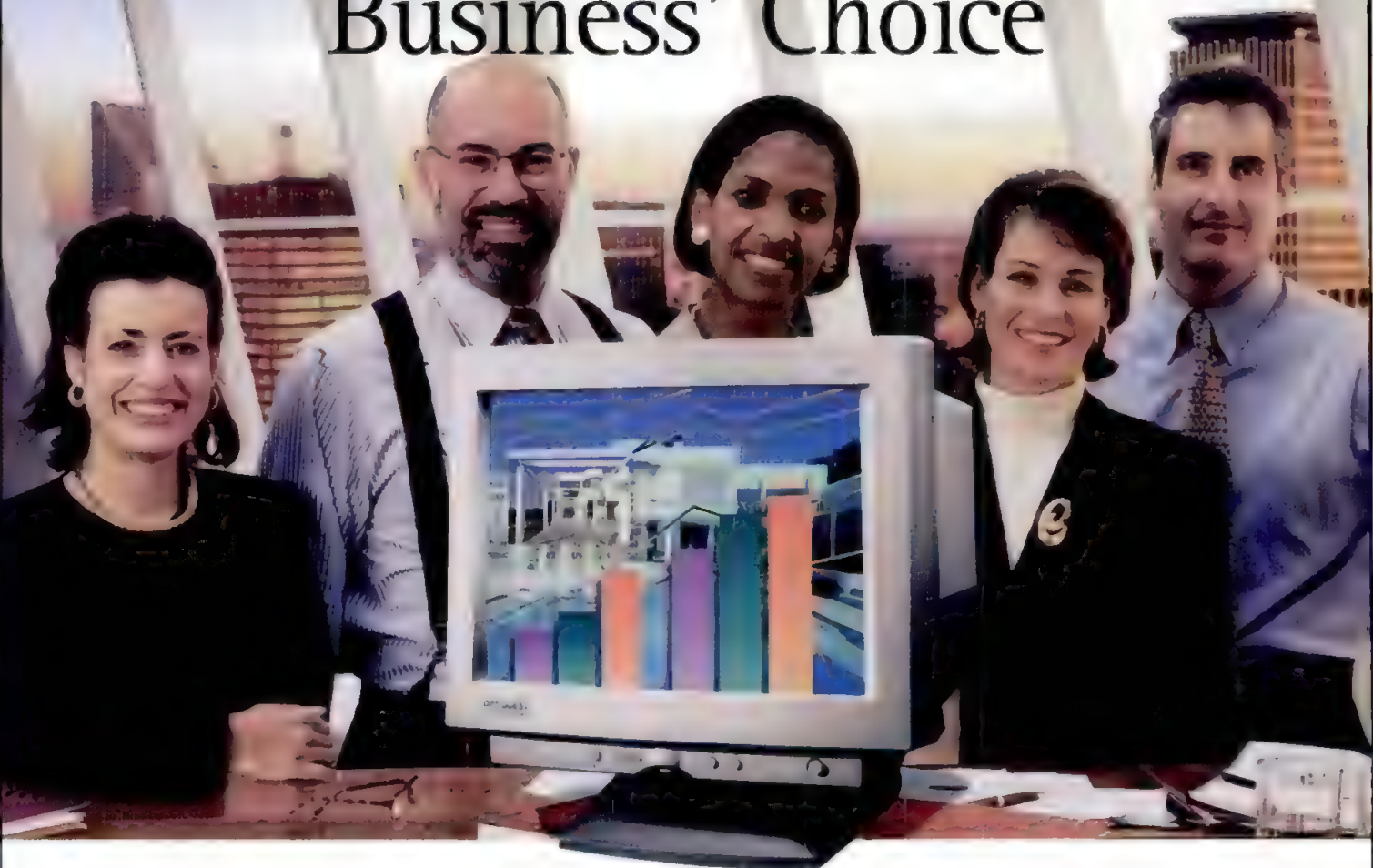
Phase 4: Redistribute. Updates destined for the dependent copies at the local nodes are later redistributed asynchronously.

Phase 5: Apply. Updates are applied to the data fragment at the local node.

Phase 6: View. Users see the updated data.

This style of processing is sometimes called bidirectional replication, although it does not actually require a replication product—it can be implemented using distributed application logic and application middleware. Today's middleware products will eventually evolve into message brokers designed to support this pro-

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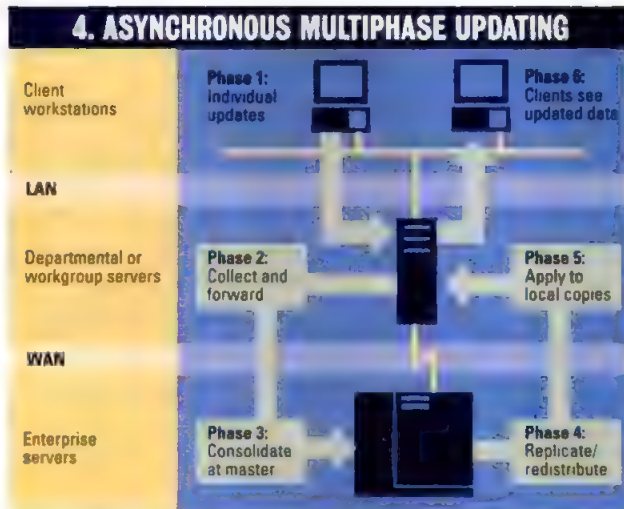
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a client workstation waits for a process running on another node in the network to complete, not only is the workstation being used inefficiently, but the user is wasting valuable time. Poor performance lowers productivity.

The ideal business information system is designed to be a real-time system for the business process. Real-time systems must always run as fast as (or faster than) the external processes they support. Similarly, a business process shouldn't be expected to wait for a computer process that is supposed to support it.

Consider: Users read, use, and update corporate information. Computers supply shared information by reading and updating databases. A responsive computer system should keep several copies of the most useful information in different locations, so that there is a copy handy whenever a user needs one.

Some high-performance applications (like banking terminals and airline reservation systems) really do require high-speed access to shared data that is both remote and current.



In such cases, every component on the path from client to remote server should be designed and monitored to ensure that it supports the workload, and all interference from lower priority work should be eliminated.

For most business purposes, however, information supplied to users does not always have to be current. Some information can be seconds, minutes, or hours out of date. Other information can be delivered as dated summaries. Users need to know only how current such information is and should be given infor-

mation appropriate for the business task. They should not have to wait for information that is more current than they need.

The computer system must keep all information consistent. Users don't care how, when, or where that happens. They should not be expected to have anything to do with the process and certainly should not have to wait for it to be done.

Software engineers and designers don't always distinguish a user's role from that of the computer. Often, the mental viewpoint is that of the computer system itself, especially when it's necessary to focus on efficiency and scalability.

During the design process, software engineers should imagine themselves in the shoes of the users for whom they are designing the perfect application. Users are the masters. The computer system should be a willing servant, doing their bidding—but unobtrusively, in the background, without ever expecting them to wait for things they don't care about. **PC**

Chris Loosley (cloosley@compuserve.com) is a principal consultant at DataBase Associates International with more than 25 years' experience in enterprise systems, software design, and software performance engineering. With Frank Douglas, he is coauthor of High-Performance Client/Server, recently published by John Wiley and Sons.

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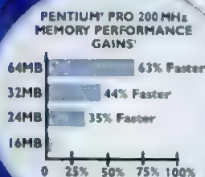
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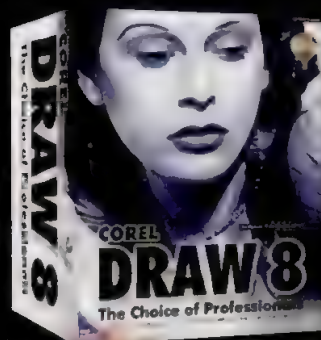


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Computer, Take a Memo

Speech recognition and dictation software gives you a real reason to talk to your computer.

By Neil Randall

Everyone on "Star Trek" converses with computers. Dave the astronaut talked to HAL. The robots on "Lost in Space" (say, now *those* were special effects...) and *Star Wars* had no trouble understanding what people were telling them. Our machines seem pathetic by comparison.

Enabling machines to understand human speech has been a goal of researchers since the earliest days of computing. Speech, the thinking goes, is the ultimate human/machine interface, because it comes so naturally to most people. Yes, there are disabilities that inhibit speech, but there are far more that inhibit the use of keyboards and mice. And even if you discount disabilities, speech interfaces are still compelling. Wouldn't it be nice if we could simply *tell* our computers what to do?

So what's the problem? A great deal, as it turns out. Human language is notoriously complex, a fact that makes the ability of three-year-olds to request, persuade, and even lie that much more amazing. To get to that point, they have to be able to produce sounds understandable as words and put words together with a meaningful syntax. And before this (or so some schools of linguistic thought go), they have to be able to understand and decode the sounds, words, and syntax they hear. In other words, they have to recognize speech.

Finding a way to program computers to understand and decode speech is the heart of speech recognition. Research in this area requires a solid understanding of both sides of the equation: language and computation. That's why speech recognition experts study fields such as linguistics, semantics, semiotics, stylistics, and rhetoric, as well as computer science and engineering. People process speech with little apparent effort; computers require a great deal of coaxing before they can even attempt it.

In the PC marketplace, two types of speech recognition software have emerged. The first enables you to speak commands to your software. Say "bold" while in Word and the bold-face style will be toggled on; say "new window" in Excel and a fresh spreadsheet will appear. This capability requires a sound board, a microphone, and software that will add speech capabilities to the application.

Several such software programs are on the market.

The second type is dictation software. Its primary goal is to emulate the venerated business practice in which a manager dictates a memo or letter to a secretary, who types the document according to the organization's standard format. From one perspective, dictation software might represent an attempt to eliminate secretaries; but in fact, it's a great tool for anyone who doesn't have secretarial help or, more importantly, anyone with disabilities that render typing difficult or impossible.

Using dictation software requires a sound card and microphone. Dragon Systems' DragonDictate and IBM's VoiceType each ship with a headphone set that offers not only

PHONEMES IN CONTEXT

Phoneme	Description
im3	Word—initial unstressed "i" followed by "m."
imp3	"M" preceded by unstressed "i" and followed by "p."
mpa4	Slightly lengthened "p" preceded by "m" and followed by stressed "a."
par4	Slightly lengthened "a" preceded by "p" and followed by "r."
art4	Slightly lengthened "r" preceded by stressed "a" and followed by "t."
rt6	Utterance—final "t" preceded by "r."

FIGURE 1: This table shows the six phonemes of the word *impair*. Phonemes are distinct sounds; the vowels and consonants of the word can overlap across multiple phonemes.

the best placement between your mouth and the microphone, but also a convenient playback device. You can use any PC microphone with this software, and you can listen to your voice and the software's audio clues through your system's speakers, but a headphone set has its advantages.

With the software installed and the microphone attached, the dictation software comes into its own. You speak into the microphone and your words appear on the screen. Some spoken words act as commands for inserting punctuation, for starting new sentences and paragraphs, and so on. Ideally, the result will be a complete, error-free document, but so far in the history of dictation software, that ideal has rarely been achieved. There is simply too much that can go wrong.

DICTIONATION SOFTWARE

To determine what can go wrong, it's necessary to look at how speech recognition software works. In such a system, the computer "listens" to a human voice, and through a series of processes it converts the spoken input into either program commands or, in the case of dictation software, text. The speech enters the computer's memory via the microphone and the sound card. The sound card captures the voice as an analog signal (which the computer cannot process) and converts the analog signal to a digital signal through sampling. This conversion starts the speech recognition process.

The recognition software then works with the CPU to process the digital values into a series of patterns. These patterns, in essence, are simplified representations of the sounds that the ear would capture and send to the brain. The simplification is necessary because, as artificial-intelligence researchers continue to discover, the brain can process far more complex signals than even the most powerful computer.

The recognition process occurs next, as the software compares the patterns with information in a database of linguistic references. For dictation software, these references range from word lists, which are essentially stored patterns the software can access with minimal processing, to a sound model and a language model that help the software return the best possible word in the best possible context.

The reference for the sound model (also called the acoustic or phonetic model) contains a variety of patterns of speech sounds. The speech recognition software takes the digitized patterns from the sound card and breaks them down into *phonemes*, the smallest distinct units of speech. In English, every word consists of one or more phonemes (which are represented in writing by a single letter or a combination of letters). For example, the word *oh* consists of one phoneme, the long "o" sound. By comparison, the word *so* consists of two phonemes, the "s" sound (a *sibilant*) and the long "o" sound. In *the*, we find the "th" phoneme and the "uh" sound (called a *schwa*). The word *beef* gives us a *voiced bilabial stop* ("b") as the initial phoneme, the *unvoiced fricative* "f" as the final phoneme, and the long "e" sound as the middle phoneme. The speech recognition software's task is to analyze the incoming digital patterns and determine what the phonemes are and how it should put them together into words.

One approach to the construction of phonemes is the idea of the *phoneme in*

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context (or PIC, in Dragon Systems' terminology), in which the sound is digitally represented by a sequence of phonemes that partly derive their value from the sounds around them. The contextual phoneme might be represented as codes for the primary phoneme, the preceding phoneme, the succeeding phoneme, and the duration of the phoneme. (The preceding and succeeding phonemes might, in fact, be silence.) The duration code specifies how long the phoneme lasts before a pause occurs (the concept is called *prepausal lengthening*). For example, two possible duration codes are 3 and 6, where 3 (the norm) indicates no prepausal lengthening and 6 represents twice the usual lengthening, as found in the vowel in the last syllable of a speech sound (and in certain other consonant-based instances).

To see the complexity of this system, look at the table in Figure 1, which is from a paper by Dragon Systems' Paul Bamberg entitled "Adaptive Phoneme Based Models for Large-Vocabulary Speech Recognition," from the Proceedings of the ESCA Tutorial and Research Workshop on Speaker Characterization. Bamberg details how the word *impart* contains six phonemes in context.

Obviously, mapping sounds to phonemic representations is anything but a trivial task. This is especially true given the differences between human voices, which we'll get to in a minute.

DISCRETE VERSUS CONTINUOUS SPEECH

Almost immediately, we encounter one of the classic difficulties in speech recognition technology. Simply put, people talk in sounds rather than words. For dictation software this is a huge problem, because to offer a transcript it must distinguish between the end of one word and the beginning of the next—and from the purely auditory standpoint, natural speech rarely makes that distinction clear. When the server at your favorite burger spot asks, "Would you like fries with that?" each word flows indistinctly into the next, and the question ends up sounding like "Wjoolike-frieswiddat?" In fact, only the convention of the written text, with its spaces between words, makes us hear the speech as individual words. Even the space is a convention; ancient Latin texts, to cite just one example, do not provide the space at all.

To solve the problem of word distinction, speech recognition software has predominantly required *discrete speech*, in which the user must pause after each word; the software reads the pause as an end-of-word marker. With discrete speech, the fast-food server's question becomes, "Would. You. Like. Fries.

With. That?" The pauses need not be as dramatic as sentence stops, but when you use most dictation software, that's how your speech quickly begins to sound. The most popular PC-based dictation packages to date—Dragon Systems' Dragon Dictate (www.dragonsys.com/marketing/dragondictate.html), IBM's VoiceType (www.software.ibm.com/is/voicetype/), and Kurzweil's VoicePro (www.lhs.com/kurzweil/pcapps/voicepluspro/default.htm)—are all based on discrete-speech technology.

You can become very proficient with discrete-speech systems, but no matter how long you use them they'll still feel unnatural, because of the pauses between words. To solve this problem, researchers are developing *continuous-speech* systems. As the name suggests, these systems let you speak with no audible distinction between words, an activity that feels more natural but also presents obvious difficulties to the software. The first continuous-speech package for PCs is Dragon Systems' NaturallySpeaking (www.dragonsys.com/marketing/pcproducts.html), which demonstrates that these difficulties are not insurmountable. The program works when you dictate in continuous speech at reasonable speeds.

One difference between the continuous- and discrete-speech methods is that the continuous-speech approach does not rely on word boundaries to represent phonemes. Instead, the software contains a much larger list of possible phonemic representations (phonemes in context) and can add to that list after the user trains it. A discrete-speech system contains approximately 1,100 to 1,200 phonemic representations for every 1,000 words in its vocabulary, whereas a continuous-speech system initially offers 3,000 phonemic representations for each 1,000 words, or even considerably more.

When you install a speech recognition package, one of the first things it asks you to do is to *train* it—that is, provide it with audio samples that correspond to the built-in dictionary and acoustic models. During a typical training routine, the software presents prose passages on the screen, and you read these aloud into the microphone. As you finish each passage, the software stores your voice's acoustic patterns in relation to the words of the passage in context. When the training is complete the software has a reasonably detailed acoustic model of your voice; when you dictate original documents, it draws on that acoustic model by comparing your speech with the words or phrases in a context similar to that recorded during the training.

Note that if more than one person will be using your dictation software, each user should train it separately. The software will store each set of voice patterns in its own file, loading the file into memory when each user logs on.

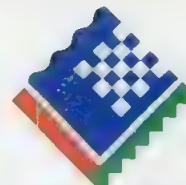
This raises another issue in speech recognition technology: *speaker-independence*. Although training works as a means of distinguishing speakers' acoustic patterns, it's a tedious exercise. Also, it shouldn't be necessary with regard to spoken commands issued to applications. Speaker-independent systems would be able to process the speech of nearly all users without individual training. But the vast differences in human speech patterns make this extremely difficult.

First, there is the problem of distinguishing between speech and noise (the rattling Venetian blinds or the hubbub in the next cubicle) and, indeed, between speech and the noise that occurs within it (throat-clearing or sighing, for example). Furthermore, there is the obvious difference between male and female voices. Pitch differs greatly between the sexes, as do less noticeable factors such as intonation, stress, and duration. Another obvious difficulty lies in dialectic differences—it's hard enough for human beings to process the speech of a person with a heavy accent, and it's even harder for a computer. Then there are the common variations—and errors—in enunciation, pronunciation, syntax, and contextual usage. Speech recognition software has to deal with all of these things.

THE FINAL STAGE

Once the software has mapped the sounds to phonemic representations and mapped the representations to words, a component called Natural Language Processing (NLP) tries to determine the best possible way to render the speech as text on the screen. It's impossible in this limited space to detail all the decisions that this component has to make; the idea is that it has to figure out how the sounds fit into a syntactic and semantic scheme. In other words, it makes the best possible interpretation of the way the sounds form words, phrases, and sentences. To that end, it parses and analyzes the utterance, attempts a number of syntactic constructions, and prints the best possible one to the screen. NLP research is constantly evolving to build better models and systems for making these decisions. **PC**

Neil Randall is the author of The Soul of the Internet (ITCP) and Special Edition Using Microsoft FrontPage 98 (Que).



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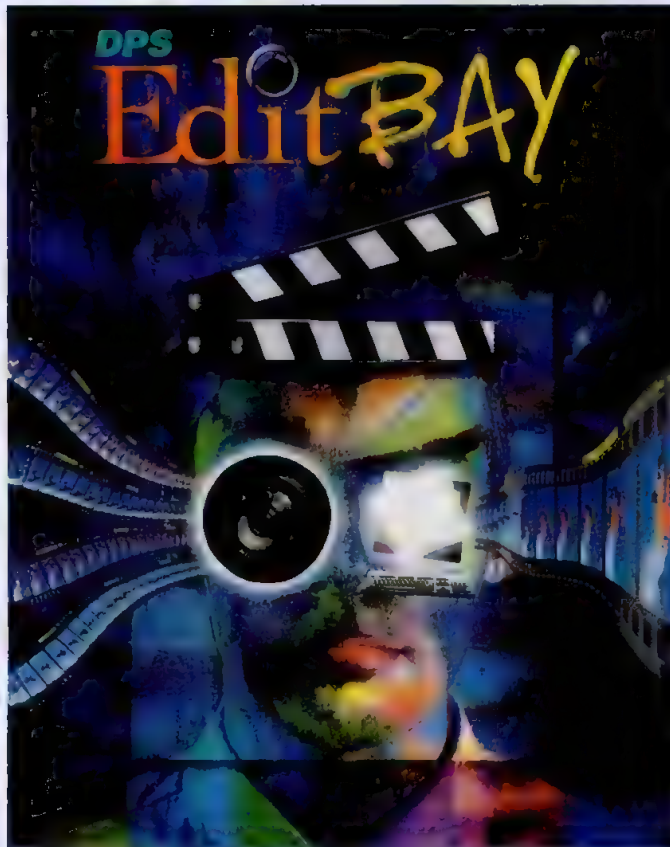
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A New Architecture for Multimedia

Microsoft DirectShow provides a better way to handle new media technologies.

By Linden deCarmo

You may be wondering why Microsoft is hyping DirectShow so feverishly. After all, DirectShow (formerly known as ActiveMovie) plays .WAV, .AVI, and QuickTime files in exactly the same way as other technologies. But though the current version of DirectShow isn't audibly or visibly superior for older content, it is a dramatic break from previous multimedia architectures, such as the Media Control Interface (MCI). As a result, DirectShow will easily incorporate support for technologies such as DVD and Digital Broadcast Satellite (DBS). In this article we will explore how DirectShow works, explain why it is superior, and examine this technology's future directions.

When the Media Control Interface debuted with Windows 3.0 and OS/2 2.0, the multimedia industry was in its infancy and very few multimedia hardware devices existed. Consequently, MCI was designed to address the needs of specific hardware platforms. In fact, the initial API revolved around playing only digital audio (.WAV) files, Musical Instrument Digital Interface (.MID) files, and digital video (.AVI) files.

MCI's designers knew they could not antic-

ipate all future devices, so they created an interface that could easily incorporate new types of hardware. Unfortunately, as new devices were added, the interface became cluttered with a poorly organized set of commands. Further, MCI requires the develop-

ment of bloated, single-function drivers to control the multimedia hardware. These monolithic drivers are expensive to create, and their code is difficult to reuse. Finally, since the MCI driver model in Windows 95 is 16-bit, programmers cannot use modern techniques (such as separation of processing into multiple threads and synchronization using semaphores).

NEW AND BETTER

Although Microsoft could have hacked MCI to address these problems, it would have been very expensive to add support for DBS, DVD, and other emerging technologies. As a result, the company decided to create DirectShow. This technology provides the following significant advantages over MCI: It does not suffer from the limitations of 16-bit MCI; it is object-oriented, and it closely models the new digital-multimedia world.

The first thing you'll notice when programming with DirectShow is that the cumbersome

restrictions of 16-bit MCI are gone. The original version of MCI for Windows 3.0 was released long before threads and semaphores were possible; therefore, when Microsoft released Windows NT and Windows 95, it had to make some compromises to get MCI to work in a multithreaded, multitasking world. The most egregious restriction is that only one thread in a process may call into the multimedia subsystem. Fortunately, these problems don't exist with DirectShow.

DirectShow is based on Microsoft's Component Object Model (COM). The use of COM ensures that every multimedia device supported by DirectShow will provide a well-defined, object-oriented interface that doesn't change, and it thus eliminates MCI's major problem—inconsistent interfaces. Since

COM is language-independent, you can write your multimedia application in C/C++, Visual Basic, Delphi, or any language that supports the creation of COM objects.

Even though COM provides a significant advantage for the multimedia programmer, it would have been unfortunate if Microsoft had simply wrapped an object-oriented COM layer around an MCI-like monolithic driver. Adding an object-oriented outer layer to procedural underpinnings would ease only application development; driver development would still be difficult. Fortunately, Microsoft totally abandoned the monolithic approach and created the concept of a *graph of filters* to process multimedia data. In computer science theory, graphs mathematically and visually represent nodes and their connections; DirectShow applies these terms to real-world technologies. A DirectShow graph has the same meaning as a mathematical graph, with filters representing the nodes in the graph. Since data flows in a specific direction between filters, a

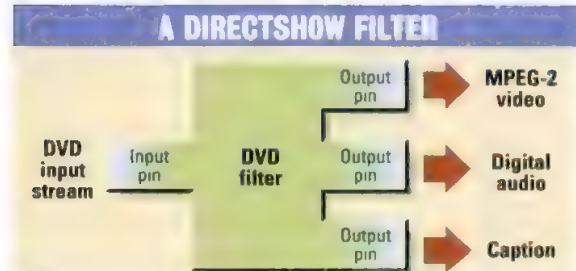


FIGURE 1: This is a DirectShow filter with a single input pin and multiple output pins. In this illustration, a DVD filter receives a DVD stream as input; separates the audio, video, and caption streams; and routes the output to the appropriate output filter.



FIGURE 2: This illustration shows how filters could be connected to play a .WAV file. The file-source filter obtains data from a file and sends it to the wave-renderer filter. The wave renderer communicates with the audio hardware to play the digital audio data.

DirectShow graph is said to be *directed*.

Most consumers who use high-tech equipment view technology as a mysterious black box. In reality, devices in our digital world are composed of a network of chips that operate on digital signals and interact. Similarly, DirectShow uses a graph of filters to process digital streams of multimedia data.

A filter is similar to a worker on a manufacturing line: It receives one or more streams of data, operates on the data, and forwards the result to the next worker(s). A filter shares data through attachments called pins, which are objects that allow data to flow into or out of it (see Figure 1). Pins are directional (for either input or output) and strongly typed (able to accept or send only specific types of data). Because of these restrictions, filters cannot be randomly connected. Note that every object in DirectShow, including filters and pins, utilizes the Component Object Model. Therefore, a programmer can easily change an object's behavior by overriding

specific methods in the object.

There are three types of filters, as shown in Figure 2: source, transform, and renderer. The type and number of pins on a filter vary with the filter category. Source filters have no input pins, since they cannot receive data. Instead, they retrieve data from a media source (such as the Internet) and send it through one or more output pins.

Transform filters manipulate data and pass it to the next filter in the graph. They use one or more input pins to receive data and one or more output pins to forward data.

Renderer filters have only input pins. They receive data and render it (or send the data to its final destination). Although most renderers communicate with hardware devices such as video displays or audio processors, a renderer may be a software entity, such as a file dump filter that writes content to a file.

If you need to write a driver for a particular hardware device or to create a software signal processor, you must first determine the category of filter to use. Then you need to determine the number of pins and the type of data each pin will accept. Once these design decisions are made, filters are much simpler to create than MCI drivers, since they deal only with the specific features required by the hardware.

When the filters are successfully connected, a graph of filters has been created and streaming (or data movement) may begin. Data is transferred from the source filter through any

Multimedia and OS/2

Although DirectShow's filter-graph architecture is new to Windows, OS/2's version of MCI has always been built atop the Stream Programming Interface (SPI), which includes the notion of source, transform, and target handlers (filters). Unfortunately, IBM

never surfaced this interface to MCI users, nor was the interface as polished as Microsoft's filter-graph architecture. Because of IBM's current focus on business users, OS/2's MCI programmers will probably never get access to SPI functionality.

THE FILTER-GRAPH MANAGER

Programmers accustomed to the simplicity of opening an MCI device will be shocked at the complexity of creating and controlling a DirectShow filter graph. To ease the pain, Microsoft created the COM-based filter-graph manager, which removes the tediousness of graph creation and simplifies graph control. It contains all of the intelligence necessary to connect filters, so a DirectShow application need only make a single call to construct a graph.

The filter-graph manager also provides an interface (called IMediaControl) to manage streaming throughout the graph. When your application sends a streaming request (such as a stop or pause) to IMediaControl, this interface sends the appropriate commands in the right sequence to all of the graph's filters. Since the filter-graph manager (like all other DirectShow components) uses COM, it is

can use a portion of it or avoid it entirely. You could connect the filters yourself and use the filter-graph manager to control streaming or, if you are really ambitious, control streaming to each filter object yourself.

Because the filter-graph manager would not be able to control all potential combinations of filters and filter interfaces, Microsoft created *plug-in distributors*, COM objects that instruct the filter-graph manager how to process new media types while remaining compatible with older applications. For example, although DirectShow 1.0 doesn't support DBS or DVD, this functionality can easily be added to all DirectShow 1.0 programs via plug-in distributors.

PROGRAMMING DIRECTSHOW

Since DirectShow is packed with features, you may be curious about how easy it is to program. When you first examine the documentation, the abundance of interfaces can be intimidating. Fortunately, most applications will use only a few of these interfaces. For instance, a typical application would use IMediaControl to control streaming, IMediaSeeking to move within the stream, IVideoWindow to manipulate the output-video window size and position, and IMediaPosition to determine media length and capabilities.

Because DirectShow is a threaded environment, many commands operate asynchronously—that is, on a different thread from your application's. Therefore, DirectShow provides two mechanisms for your program to determine how each command is progressing. One alternative is to poll (or constantly request command status for) the state of the graph via the IMediaControl interface. Although this approach is legal, it is highly undesirable, since processing power is wasted while the program is waiting for an event to occur. Furthermore, some digital media streams (such as DVD) may dramatically change their presentations without direction from the application. Polling within such data streams is unreliable, because missing an event between

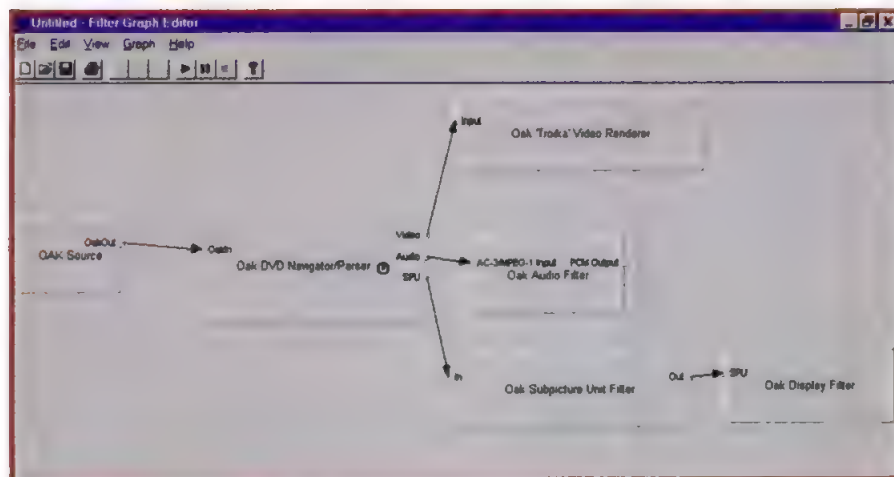


FIGURE 3: Using the GraphEdit tool in the DirectShow SDK, you can visually construct a graph to play back DVD movies.

transform filters to the renderer filter(s). Because every filter has its own mechanisms to control data movement (such as starting and stopping), each filter must be separately informed when to start, stop, or pause streaming. Further complicating matters, filters must be started and stopped in a specific sequence; otherwise hangs could result.

object-oriented and extensible.

Although the filter-graph manager makes the life of the average multimedia programmer easier, advanced programmers may fear that this simplified interface offers less functionality and will actually hinder development. Fortunately, DirectShow development does not absolutely require the interface. You



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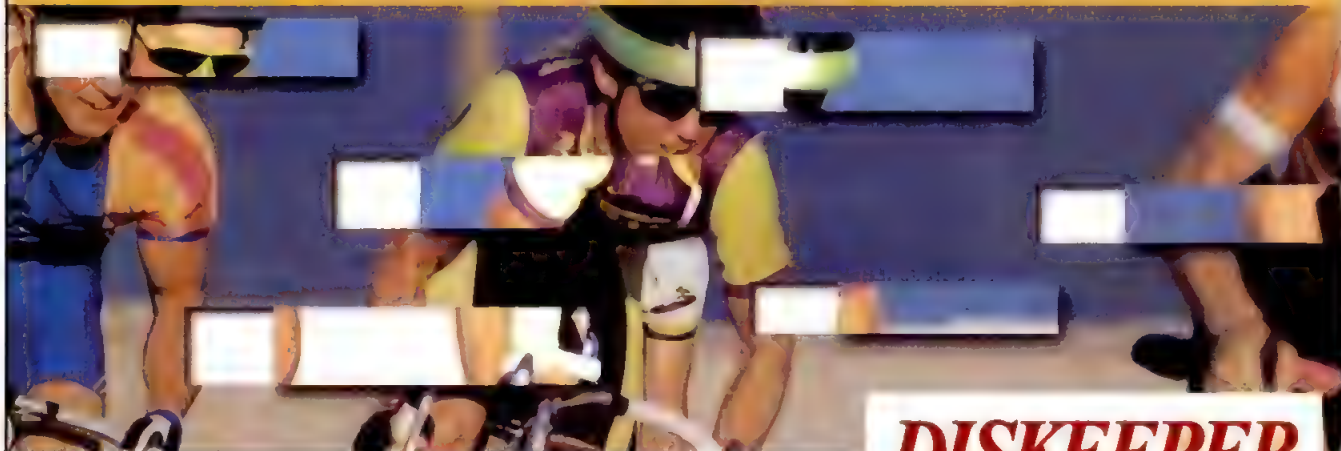


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polling cycles could make your program hopelessly out of sync with the stream.

The second notification option is the use of asynchronous events. When the status of the stream changes (for example, an error occurs), DirectShow posts an event and sets a semaphore to alert your application that the graph's status may have changed. Since properly written DirectShow programs must listen for this semaphore (via `WaitForSingleObject` or similar calls), your program will wake up and retrieve this event (via the `GetEvent` method of the `IMediaEvent` interface) in a timely fashion. The advantage of asynchronous events is twofold: Since applications react to events rather than polling, no processing power is wasted and your programs will remain in sync with the data stream.

Now that you have an overview of how filters and the graph manager work, you'll want to start experimenting with DirectShow. Microsoft provides a tool called GraphEdit (Graphedt.exe) in the DirectShow toolkit, which lets you visually construct a graph (see Figure 3). Simply double-click on a filter and it shows up in the graph. When you have a couple of filters in the graph, you can connect them by selecting the output pin of a filter, dragging your mouse to the target filter's input pin, and dropping the pointer on the

input pin. If the pins are compatible, GraphEdit will show a visual connection between the filters. Then you can hit the **Play** button in GraphEdit to hear (or see) the results of your creation.

You'll find that GraphEdit not only helps you see what happens when you construct a graph but can be an aid in debugging. By using GraphEdit, you can determine whether a bug is occurring in a filter, in the graph manager, or just in your application.

Since GraphEdit uses public DirectShow interfaces, you can harness all of its power in your programs. In fact, if you're adventurous enough, you can create your own version of GraphEdit. For instance, you may use the `AddFilter` method of `IFilterGraph` to add a filter to the graph. Once you have added a couple of filters, you can use the `ConnectDirect` method of `IFilterGraph` to connect their pins. Finally, if you run into an error or even if you just hate the graph you've created, you may use the `Disconnect` and `RemoveFilter` calls in `IFilterGraph` to trash the filters so you can start anew!

Although Microsoft is emphatic that DirectShow will ultimately replace MCI, some features are missing from the initial release. For example, there is no mechanism to record digital video. Microsoft has

promised to include these features in the second release of DirectShow. Version 2 is also expected to contain interfaces for controlling DVD video, supporting the Windows Driver Model (WDM), and enabling recording digital audio.

Even though existing multimedia content plays back just as it did before, DirectShow nevertheless is a dramatically different multimedia environment compared with the venerable MCI architecture. In fact, since DirectShow more closely models consumer electronic devices, it can accommodate technologies that are virtually impossible with MCI. As advanced technologies such as DBS and DVD become integrated within DirectShow, this environment's advantages will become increasingly obvious. If you would like more further information, check out www.microsoft.com/devonly/tech/amov1doc/ and www.pcwebopaedia.com/ActiveMovie.htm. **PC**

Linden deCarmo is a frequent contributor to PC Magazine. He is a staff software engineer at Oak Technology, where he works on the Interactive DVD Browser—the first publicly available ActiveMovie/DirectShow DVD playback environment for Windows 95. If you have DVD or DirectShow questions, you can contact him at llinden@ibm.net.

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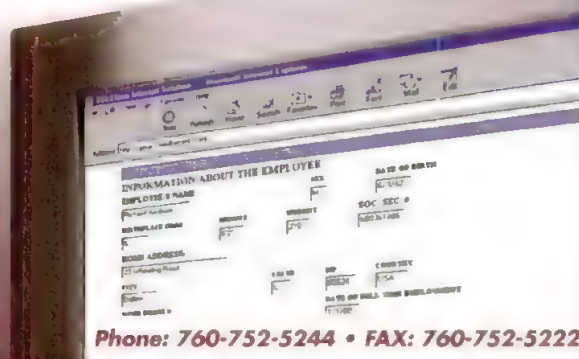
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Internet Connection Alternatives

Tired of slow modem access? Here are four technologies that can turbocharge your connection.

By Paul Modzelewski

Your Internet connection can have a large impact on how—and how well—you use your computer. As the power of the home PC continues to grow, it seems modem speed is always the weakest link in the chain. Even a 56K modem can seem painfully slow if you are spoiled by a high-speed connection at work or school.

The technology in residential telephone lines, or POTS (plain old telephone service), has remained basically unchanged for decades, with all its built-in limitations. POTS is designed to carry streams of analog data, not packets of digital data. Even if analog modems were able to achieve very high capacity, their latencies would be a drag on connection speed. And when you use a POTS line for Internet access, your phone line is unavailable for voice calls.

In this article we'll discuss four alternatives to analog phone connections to the Internet. Two are readily available now, and the others are just over the horizon.

- ISDN (Integrated Services Digital Network), the most widely used high-speed digital service, is offered by nearly all local phone companies.
- DirecTV, the satellite television provider, offers Internet access by satellite dish. You can use the service anywhere in the continental U.S.
- Cable modems provide Internet access through your cable TV wire. Many cable companies are testing them now.
- ADSL is a new digital technology that offers very fast connections over existing telephone wires. It's still quite expensive and not yet widely available.

The table on the right summarizes the pros and cons of each connection type.

ISDN

No matter where you live, you probably can install an ISDN line. ISDN is standardized across the country, so you can purchase an inexpensive adapter with little worry about compatibility.

The ISDN service suited for residential use—BRI (Basic Rate Interface) ISDN—makes use of two 64-Kbps channels, called *B*

channels. The *B* channels can be combined for a maximum capacity of 128 Kbps, roughly four times the capacity of a 28.8-Kbps analog modem. Because ISDN is a digital network, it's more efficient than POTS at carrying packets of data on the Internet. For activities that send small amounts of data frequently, such as Internet gaming, it may seem far more than four times as fast as an analog connection.

You can make POTS voice calls on an ISDN line, and many adapters allow you to use your phones. Each *B* channel can carry a POTS call, so you can access the Internet on one *B* channel and make or receive a voice call on the other. Some ISDN adapters let you use both *B* channels to access the Internet and shut down one *B* channel to let you answer an incoming call.

ISDN also has a third channel, called the *D* channel, which has a maximum capacity of only 16 Kbps. The *D* channel was designed for signaling (to indicate the line is busy, for instance), and its bandwidth is usually not available to you. However, some phone companies allow you to use the *D* channel as a continuous connection to the Internet. Because the *D* channel has low throughput, it is well suited to sending and receiving relatively small amounts of data at regular intervals, like

e-mail or stock quotes. The primary advantage of such a service is that you can get small amounts of data without placing an ISDN call, which often incurs per-minute charges.

Pricing for ISDN lines is different in each area of the country, but the fluctuations are fairly small. You can expect to pay a \$125 installation fee, and you may also pay a one-time line charge of around \$30. Add to that a good ISDN adapter for \$200 to \$250 and your start-up costs will range from \$325 to \$400. You will also pay the phone company a monthly fee for the line, which should be from \$30 to \$50, depending on where you live and how much you use the line. You will also need an ISP (Internet service provider); you may be able to use your current one. The ISP should cost \$20 to \$40 a month for unlimited usage. You could save some money and get rid of your POTS line, but the phone companies don't recommend it, because unlike POTS lines, ISDN lines do not work if your electricity goes out.

CABLE MODEMS

There are several standards for cable TV data networks in the U.S., but that should not be a problem for a consumer. Cable companies follow business models much like those of their cable TV services, and they choose and install the equipment you need in order to use their data services.

Cable modems, which employ your coaxial cable TV line to send and receive data, come in two basic types: *symmetrical* and *asymmetrical*. Symmetrical modems send and receive data at the same speed. Asymmetrical modems receive data faster than they can send it.

INTERNET CONNECTION FACTS

Service type	Connection speed	Cost	Pros	Cons
ISDN	128 Kbps	Start-up, \$325-\$400 monthly, \$50-\$80	Available almost everywhere. Equipment and protocols are standard throughout the U.S. Frees your standard phone line.	Monthly fees must be paid to both the phone company and an ISP. The performance is not on a par with other emerging digital technologies.
Cable modem	2 Mbps	Start-up, \$100 monthly, \$40	Very fast connection. Low start-up and monthly costs. Frees your standard phone line. No separate ISP required.	Not yet widely available. Sharing bandwidth with many users means potential slowdowns. Security issues for shared resources.
Satellite dish	400 Kbps	Start-up, \$550 monthly, \$40-\$130	Can be used anywhere a satellite dish can be installed, even on a boat or an RV. Available in rural areas that may not be covered by other alternatives.	Only the downstream connection is improved. Your standard phone line is still used. Expensive: You must pay monthly fees to both DirecPC and your dial-up ISP.
ADSL	1-5 Mbps	Start-up, \$2,000-\$3,000 monthly, \$200-\$1,000	Uses existing copper phone wires. Fast.	Confusion over standards. Very expensive to set up. Not available in all areas. Some security issues.

Cable modem performance varies across the country, and most companies are reluctant or unable to give exact performance statistics. That's because the data bandwidth on a cable modem network is shared by groups of users. As the number of users online increases, each user's share of bandwidth goes down.

You can realistically expect peak speeds of up to 2 million bits per second, compared with 128,000 bps for ISDN or 28,800 bps for a modem. Most asymmetrical cable modems have an upstream speed of about 512,000 bps. But at least one cable company requires the use of your standard phone line for upstream transmissions, although that seems to defeat two benefits of a cable connection: providing faster access and freeing the phone line.

Most cable modems link to an Ethernet adapter card in a PC, effectively making your computer a node on an Ethernet network. That means your Internet connection is always instantly available, and logging on is no longer required. Not having to log on may seem a small thing, but it makes a big difference in the way you use the Internet. In addition to the added ease, however, there's a security issue. Because your computer is always logged on to a network, any resources that you have marked as shared (without requiring a password) can be hacked by someone else on the network.

Jones Intercable, in northern Virginia, offers what it calls the Internet channel. Price and performance are on a par with those of other cable services around the country. A \$99 installation fee includes cable modem and Ethernet card. The monthly fee is \$40 for unlimited usage. Jones acts as the network provider and the ISP, providing you with e-mail, newsgroups, and Web page hosting. You don't have to pay any additional fee to a third-party ISP.

SATELLITE DISH

Satellite dishes have an advantage over the other technologies discussed here in that they require no infrastructure. If you are in the continental U.S. and have somewhere to put a 21-inch dish facing south, you can get this service. And if you live in a rural area, a satellite dish may be the only high-speed Internet connection available to you.

The only such service available right now is DirecPC, which is owned by DirecTV, a satellite TV service provider. (A DirecDuo option is available for those who want to receive Internet access and cable TV channels through the same satellite dish.) Installation is straightforward, but you will need to climb onto your roof. DirecPC offers professional installation for an additional fee.

The maximum throughput of DirecPC's

dish is 400 Kbps. This is more than three times the speed of ISDN, but there is a caveat: The dish can only *receive* data. You must have a dial-up connection to send. That means your phone line is still tied up and you still have to pay a monthly fee to your ISP.

Once DirecPC is installed, your upstream link to the Internet is unchanged. All of your data requests are fed to a central connection point that has a very high-speed connection to the Internet. The data you request is downloaded from its source to the connection point. As the data is received at the connection point, it is bounced off the satellite and is received by your dish. That's a long trip for the data, so DirecPC's latency is significant, but transfers of large files are very fast. DirecPC's interface is shown in Figure 2.

Hardware for DirecPC costs \$499, and there's a start-up charge of \$49.95. Various

The introduction of cable modems in many areas is also prompting the RBOCs to move more quickly.

An ADSL line requires two modems, one on the "subscriber" side, and one on the telephone company's or ISP's end. The subscriber can place calls only to the modem at the other end of the line. That means you cannot place direct calls to other ADSL-equipped computers. Using ADSL for Internet service is a perfect fit, since your ISP is on the other end of the line. That does pose security issues, and if security is a concern, you may want to look into ISDN, which provides more secure direct connections.

Setting up a new ADSL line costs around \$3,000. Prices are predicted to drop to between \$500 and \$1,100 in 1998. The decrease will result mainly from lower modem prices.

SUMMARY

Deciding which alternative access method to go with is mostly a function of what is available in your area. You should contact your local cable and phone companies to see whether they have any offerings or plans for the near future.

You may even want to call your electric company. Some electric companies have been installing fiber-optic lines with new power lines for several years. The fiber is installed to allow remote diag-

nostics on the power lines, but with the boom of the Internet, many electric companies are considering selling the extra bandwidth to anyone who wants it.

It is important to remember that in many cases the Internet or part of the Internet that you are accessing is to be blamed for poor performance, and no amount of bandwidth into your computer will cure that problem. Sites with heavy traffic or slower connections abound. On the upside, slow connections use only a small portion of your bandwidth, so you can perform other tasks while they download in the background.

One last note: High-speed Internet connections are addicting. Once you have used one for a while, you can't imagine going back. When it takes only a couple of seconds to download even the most data-intensive pages, exploring the Web is much more compelling. **PC**

Paul Modzelewski is a software engineer at Group Logic. He can be reached via e-mail at paul@grouplogic.com.



FIGURE 2: DirecPC's custom interface software has recently been redesigned.

pricing schemes based on time of day and megabytes downloaded range from 60 cents per megabyte for night access to \$129.95 per month for unlimited daytime access. Access at 200 Kbps is also cheaper than at the full 400 Kbps, with unlimited nighttime service costing \$24.95 per month.

ADSL

ADSL (Asymmetric Digital Subscriber Line) is a new digital networking technology that runs on existing copper telephone wires. Typical performance for these devices is around 1.5 Mbps for downloads and 64 Kbps for uploads. Newer technologies are being developed, and there is some contention about standards.

In Canada, a leader in adoption of ADSL, three of the ten major telephone companies offer ADSL service. In the U.S., the Regional Bell Operating Companies (RBOCs) are dragging their feet. Some ISPs are offering direct connections that bypass the RBOCs, which has attracted the phone companies' attention.

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Share Your Bookmarks Between Browsers

Synchronize your Internet Explorer and Navigator bookmarks with SyncURLs.

By Gregory A. Wolking

If you're like most people, you access the Internet with more than one browser. Perhaps you use computers both at home and at work, and run a browser on both machines. Or perhaps you have just one machine, but like to use Netscape Navigator for some tasks and Microsoft Internet Explorer (IE) for other tasks. When you use more than one browser, it takes very little time for your bookmarks to become hopelessly out of sync. Before long, you find yourself wishing, for example, that you could access your home machine's Navigator bookmarks when running IE at work. This issue's utility, SyncURLs, provides a solution.

SyncURLs is a 32-bit application that runs under either Windows 95 or Windows NT 4.0. It imports your Navigator bookmarks and IE Favorites into a single bookmark library. You can rearrange your bookmarks within SyncURLs, then export them back out to one or both browsers with a single command. This synchronizes the browsers so that they both contain exactly the same bookmarks and folders. SyncURLs also lets you save your bookmark libraries to disk in a proprietary compact format so that you can easily transport your bookmarks from one computer to another.

You can obtain SyncURLs by downloading it from PC Magazine Online or by mail. (Refer to the sidebar "Getting the Files" for details.) The source code for SyncURLs, written in Microsoft Visual C++ 5.0, is also provided for those interested in seeing how it works.

INSTALLATION

To install SyncURLs, place the program's component files (Syncurls.exe, Syncurls.hlp, and Syncurls.cnt) into the folder of your

choice, then create a shortcut to Syncurls.exe. To remove the program, run it once from the command line with the /uninstall switch, answer the confirmation prompt, then delete the component files. All of the program's controls and functions are documented in the online help.

DUELING BROWSERS

Before you use SyncURLs, you should understand the different ways Navigator and IE store your bookmarks. These differences sometimes require SyncURLs to reorganize or

SyncURLs

SyncURLs imports your Navigator bookmarks and IE Favorites into a single bookmark library. You can rearrange your bookmarks within SyncURLs, then export them back out so that both browsers contain the same bookmarks and folders.



rename your bookmarks before merging them into an exportable bookmark library.

Navigator stores your bookmarks in a single file, named Bookmark.htm. The bookmarks themselves are logical objects created using HTML tags in the file. By contrast, IE stores your bookmarks as physical files (Internet shortcuts named with the .url extension) and folders on disk. Because of this difference, your Navigator bookmarks cannot always be transferred to IE verbatim.

The specific limitations on this process and SyncURLs' handling of them are shown in Figure 1.

There is one other important difference between Navigator and IE regarding bookmarks. Navigator's Bookmark.htm file contains nothing but bookmarks. IE's Favorites folder may be used by other applications and thus may contain other file types besides Internet shortcuts. For safety's sake, SyncURLs will not touch any file in your Favorites folder that is not an Internet shortcut.

USING SYNCURLS

When you launch SyncURLs, it automatically imports and merges all of your existing bookmarks and displays them in a tree view (Figure 2). Note that you don't have to worry about the physical locations of these files and folders; SyncURLs looks them up in the system Registry.

Think of this tree as a "virtual workspace." Changes you make within SyncURLs do not affect your current bookmarks unless and until you tell the program to update your browsers using the commands on the Export menu. The Save command does not affect your browser configuration, either. It simply saves the current workspace in SyncURLs' own format. These files, called bookmark libraries, are named with the .bml extension and can be used to transport your bookmarks from one machine to another. SyncURLs automatically registers this new file type with Windows Explorer.

Each item in the bookmark library tree is marked by one of three icons. A padlock icon indicates a folder that exists on disk as part of your IE Favorites tree. To avoid possible conflict with other applications, SyncURLs does not allow you to move, rename, or delete these folders directly. A folder icon indicates a bookmark folder (either imported from Navigator or created within SyncURLs) that does not have a matching physical folder on disk. These folders can be moved, renamed, and deleted as you see fit. A page-corner icon indicates an individual bookmark. You can move bookmarks to any folder (locked or not), rename them, or delete them as you desire.

FOR PROGRAMMERS ONLY SyncURLs was written with Microsoft Visual C++ and Microsoft Foundation Classes (MFC). The full source code for SyncURLs is available on PC Magazine's Web site (www.pcmag.com) and demonstrates the following programming techniques:

- manipulating Internet shortcut files using OLE;
- handling tree-structured data using recursion;
- sorting the contents of a CTreeCtrl object (a Windows 95 tree control) on two different keys by deriving a new class.

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RESOLVING BROWSER DIFFERENCES

Differences Between Navigator and IE Bookmarks		How SyncURLs Handles the Differences
Length	Navigator allows folder and bookmark names to be as long as you wish and lets you nest folders as deeply as you wish. IE is limited by the file system, so the fully qualified path to any bookmark file cannot be longer than 255 characters.	SyncURLs does not allow the path to any folder to exceed 200 characters. If the path is too long, SyncURLs creates a folder named Relocated, placed directly under the root folder. It then creates the target folder as a child of the Relocated folder. SyncURLs truncates bookmark names to 50 characters. When combined with the folder relocation outlined above, this guarantees that your bookmarks and folders will not exceed the file system's naming limit.
Allowable characters	Navigator allows folder and bookmark names to contain any printable characters. IE cannot use certain characters because they are not legal for use in filenames.	SyncURLs changes illegal characters in bookmark or folder names to dollar signs.
Name duplicates	Navigator allows a folder to contain more than one folder or bookmark with the same name. IE cannot, because folder names and filenames must be unique within a given folder on-disk.	If a folder contains multiple folders with the same name, SyncURLs merges their contents into a single folder with that name. If a folder contains bookmarks with the same name and the same URL, SyncURLs considers them to be exact duplicates. It retains the first bookmark and discards the rest. If a folder contains bookmarks with the same name but different URLs, SyncURLs renames the additional bookmarks by appending numeric extensions in parentheses.
Blank names	Navigator allows a folder or bookmark's name to be completely blank. IE cannot, since folders and files on-disk must have names.	If a folder name is blank, SyncURLs supplies the name Folder followed by a number in parentheses. For a bookmark without a name, SyncURLs creates a name using the URL to which that bookmark points.

FIGURE 1: This table details the differences between Navigator and Internet Explorer with regard to how bookmarks are stored and shows how SyncURLs handles conflicts.

Each folder has a check box next to it that lets you select which folders will be exported. All folders are selected automatically when you start the program or load a bookmark library. When the selection box contains an x on a white background, that folder and all of its children (the files and folders beneath it) are selected. If the box has a gray background, the folder and all the files beneath it are selected but one or more of its child folders is not. To change a folder's selection state, just click on the box. Selecting or deselecting a folder automatically selects or deselects all of that folder's children.

While importing, SyncURLs records its progress, including any adjustments or errors, to an ASCII text file named *Implog.txt*, which is stored in the same directory as *Syncurls.exe*. If appropriate, it presents a message box to let you view the log to see exactly what happened during import. Note that the log is not cumulative; SyncURLs rewrites the file every time it imports bookmarks, so you don't have to worry about the file consuming ever-increasing amounts of disk space. On most systems, the log file will rarely be larger than a few kilobytes.

ORGANIZING YOUR BOOKMARKS

SyncURLs supports drag-and-drop for rearranging your bookmarks and folders. Click on the item you want to move with the left mouse button, drag it to the desired destination, and drop it. The *Expand All* command

on the View menu will open all folders in the tree, making all items accessible for the drop operation. Dropping an object directly on a folder places the object within that folder. Dropping an object on a bookmark places that object within the same folder as the bookmark. In either case, the item you drop will be inserted in sorted order; the tree is sorted by name—folders first, then bookmarks.

If the desired destination is not visible in the window, drag the mouse pointer beyond the window's boundaries to scroll the tree in the corresponding direction. The *Scrolling Speed* command on the Options menu lets you control how fast the window will scroll. On most machines the default setting (maximum speed) will be fine, but on very fast machines you'll need to slow it down a bit. Otherwise, the window will scroll so fast you'll reach the end of the document before you have a chance to react.

There are some limitations to the drag-and-drop operation. Locked folders cannot be dragged, and folders cannot be dragged to their own children. If you want to drop an object into a folder that already contains an object with the same name, you must first rename the object. To rename a folder or bookmark, start by selecting it. You then have four options. You can click again anywhere within its name, select *Rename* from the Edit menu, press Ctrl-R, or

right-click on the object and select *Rename* from its pop-up menu.

Whichever method you use, the item's name will change to an edit box so you can edit the name as desired. If you change your mind, press Alt-Backspace to undo your editing and restore the original name. To complete the operation, click anywhere outside the edit box. If the new name is invalid, the program will present an appropriate error message and restore the original name.

If you change your mind and want to cancel a drag operation, you have three options. You can drop the item you're dragging back on itself, click the right mouse button before releasing the left mouse button, or move the mouse pointer outside the window's boundaries before releasing the left mouse button.

To delete a selected object, choose *Delete* from the Edit menu, press Ctrl-Del, or right-click on the object and select *Delete* from the pop-up menu. You cannot delete a folder unless it is completely empty. Because deletions cannot be undone, by default the program presents a confirmation prompt before it deletes any object. You can disable the confirmation prompts for folder and bookmark deletions via the Options menu or the toolbar.

To eliminate multiple bookmarks that point to the same URL, use the *Weed Duplicates* command on the Edit menu. This command scans the entire library and locates all bookmarks that point to the same URL, regardless of their names or the folders in which they reside, and lets you decide which of them you wish to keep. The program will present a dialog box containing a list divided into sections, each section beginning with a heading

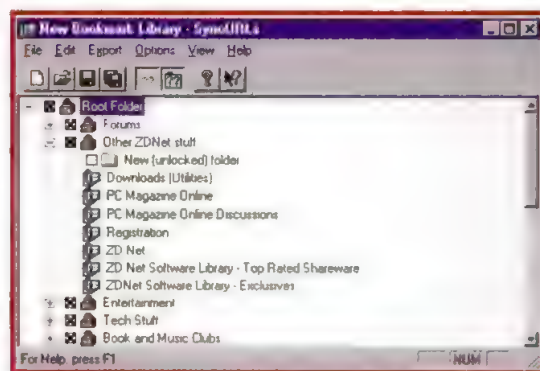


FIGURE 2: SyncURLs merges the bookmarks from all your browsers and displays them together in a tree structure.

showing one URL. Beneath each URL you'll see the names of the bookmarks that point to it, with check boxes beside them. Check the box next to the bookmarks you want to keep, then click on the *OK* button. If you don't check at least one bookmark for each URL, SyncURLs will present a warning prompt, in

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case that's not what you intended.

The *Find* and *Find Next* commands, also on the Edit menu, let you locate a bookmark based on text contained in its name, its URL, or both.

To view detailed information about a bookmark, either select the bookmark and choose *Properties* from the View menu, or right-click on the bookmark and choose *Properties* from its pop-up menu. The resulting dialog displays the name of the bookmark and its URL, as well as the date the bookmark was created, last modified, and last visited.

Finally, you can create new, empty folders using the *New Folder* command, either from the Edit menu or from an existing folder's pop-up menu. The new folder will be created with a default name, already selected for editing. Edit the name as you desire, then click anywhere outside the edit box to complete the operation.

MANAGING BOOKMARK LIBRARIES

When you load a bookmark library file, the process is a little unusual compared with other applications. SyncURLs will always reimport all bookmarks from your browsers after it loads your library. The resulting document will contain a combination of the data loaded from the file and the bookmarks that already exist on the target system. This may seem awkward but is necessary for two reasons. First, in order to handle your Favorites folder safely and efficiently, SyncURLs must read your disk so that it knows which folders already exist. Second, if you are moving your bookmarks to a system whose bookmark organization is radically different from that of the original system, this method prevents you from accidentally destroying existing bookmarks on the target system when you export.

Similarly, the *File | New* command behaves differently from similar commands in other applications. Instead of creating a new, empty document, this command discards the current library (after prompting you to save it if necessary), then reimports your bookmarks from scratch. Therefore, whenever you start the program, use *File | New* to create a new library, or use *File | Open* to load an existing library file, the resulting library will always contain all bookmarks currently present on your system.

The *Save* and *Save As* commands on the File menu always save your entire library to disk, regardless of which folders you have selected for export (see below). The resulting bookmark library file is fairly compact; it will usually be less than half the size of a *Bookmark.htm* file containing the same information. Thus you can save thousands of bookmarks to a standard 1.44MB floppy disk. Since the bookmark library file format consists

mostly of ASCII text, it will usually compress by 75 percent or more when processed with an archiving program such as PKZIP.

EXPORTING YOUR BOOKMARKS

Exporting your bookmarks to Navigator is straightforward. When you select *Netscape* from the Export menu, the program first makes a backup of your *Bookmark.htm* file by renaming it with the *.bak* extension. If the backup copy already exists, the program asks whether you want to replace it. Next, the program writes a brand-new *Bookmark.htm* file based on the information in your current library. Only folders that are selected (checked) will be written to the file. If you have not selected any folders, the resulting *Bookmark.htm* file will be completely empty except for its page title and document ID information, so the program presents a warning message before it begins the export process. If any errors occur during export, the program will automatically restore your *Bookmark.htm* file from the backup copy.

Note that Navigator should not be running when you export bookmarks to it. If it is, Navigator may get out of sync with the *Bookmark.htm* file. If you forget and do an export while Navigator is running, you should use Navigator's *Go to Bookmarks* command to open its bookmark-editing window, then close the window. If that window is already open, just close it. In either case, Navigator will detect that the file on disk has changed and ask whether you want to reload it. IE, on the other hand, can safely be left running while you export bookmarks to it.

If you do not have Navigator installed, the *Export Netscape* command will be disabled. However, you may still use the *Export HTML* command to export your bookmarks in HTML format. This command writes exactly the same type of file as the *Export Netscape* command, but it lets you select the name and location of the file, and it does not make a backup copy if the file you select already exists. Similarly, the *Import HTML* command on the File menu lets you read any Navigator *Bookmark.htm* file and add its contents to the current library. This is handy if you only use IE but have a friend who uses only Navigator, since it lets you share bookmarks even if your friend doesn't have SyncURLs installed.

Exporting bookmarks to IE is a little more complicated. Because your IE bookmarks represent physical files and folders on disk, SyncURLs has to be careful, especially when handling unselected folders. When you export to IE, SyncURLs will automatically remove any existing *.url* files from your Favorites folder

tree, but it will not touch any other file types. If a folder is not selected in the tree and it is empty after the *.url* files have been deleted, SyncURLs will delete that folder and show it as unlocked in the tree when the export is complete. Note that SyncURLs will never delete the Favorites folder itself, only the empty subfolders and *.url* files it contains.

If your Favorites folder and its children contain nothing but *.url* files and none of those files are marked as read-only, it is possible to have SyncURLs unlock all folders in the current library so you can freely rearrange all your bookmarks and folders before exporting them. The basic idea is to read your folders and bookmarks into SyncURLs, delete the files on disk that correspond to them, use SyncURLs to rearrange your folders and bookmarks as you like, and then write them back out to disk. Since this procedure involves deleting your folders and bookmarks on disk, you must make very sure that you have backed them up.

To unlock all your folders, first save the current library to disk, using either the *Save* or *Save As* commands. Next, clear the selection box for the root folder so that all folders become unselected. Finally, select *MSIE Bookmarks* from the Export menu and acknowledge the warning prompt. Once the export command finishes, all of your IE bookmarks will be deleted from disk, so it's extremely important that you first save your library (or back up your Favorites folder by some other method). If you do not, you will have no way to recover your bookmarks if you forget to reselect your folders and export them to IE before you exit the program.

At this point you can rearrange your bookmarks as you wish. When you are done, check the root folder selection box and again select *MSIE Bookmarks* from the Export menu. This will copy your rearranged bookmark library to the Favorites folder. Don't forget to export your bookmarks after you're done rearranging them, or you won't have any IE bookmarks!

INSIDE SYNCURLS

I wrote SyncURLs using Microsoft Visual C++, Version 5.0, and created the basic framework with the MFC AppWizard. SyncURLs is a Single Document Interface (SDI) application whose view class (*CSUView*) is derived from the MFC *CFormView* class. The program's main form contains a single *CTreeView* control that is accessed through a single member variable, *m_tvFolders*.

To store your bookmark data efficiently, the program's document object, *CSUDoc*, uses two arrays. The first array, pointed to by the

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`m_pPathList` member variable, contains the path information. The second array, pointed to by the `m_pDocElements` member variable, contains the data for each URL. `CSUDoc` maintains these arrays dynamically, so `SyncURLs` doesn't waste memory.

This method consumes far less memory and disk space than using a single array and storing the full path to each bookmark in each element. It also eases communication between the tree control and the document's data. Each folder item in the tree stores the offset to its path in the `m_pPathList` array, and each bookmark item stores the offset to its data in the `m_pDocElements` array.

IMPORTING BOOKMARKS

Importing from Navigator is fairly straightforward. Navigator uses HTML code to store your bookmarks, so it was not difficult to design a function to parse the file. Except for reading and validating the file header, `SyncURLs` uses a single call to `CSUDoc::Parse_NS_Folder` to read your bookmarks. `Parse_NS_Folder` is a recursive function. Each time it encounters an HTML tag that indicates the start of a folder, it calls itself to process that folder.

Reading IE bookmarks was a stumper until I realized that .url files are shell objects, and so there must be a way to access them via OLE. After digging around in VC's online documentation, I finally found it: the `IUniformResourceLocator` interface. To eliminate the overhead involved in allocating and releasing OLE objects, the `CSUDoc` object creates and initializes its OLE pointers, `pIPF` and `pIURL`, in its constructor (`CSUDoc::CSUDoc`) and releases them in its destructor (`CSUDoc::~CSUDoc`).

The `pIURL` pointer is a reference to the `IUniformResourceLocator` object. The `pIPF` pointer is a reference to that object's `IPersistFile` interface. Note that the `IPersist-`

`File` interface is common to all OLE objects that can be stored as files on disk. It gives applications a common way to read and write the files for any such OLE object.

`CSUDoc` uses these pointers to instantiate a single `UniformResourceLocator` object, then uses that one object repeatedly to read and write .url files. To see how this is accomplished, examine the code for the `CSUDoc::Scan_Folder` and `CSUDoc::Export_MSIE_Path` functions.

WORKING WITH THE TREE CONTROL

The `TreeView` common control, one of the new common controls introduced with Windows 95, makes it easy to give the user a tree-structured interface to your program's data. MFC encapsulates the functionality of this control in the `CTreeCtrl` class. Most of the program's interface with its tree control is straightforward, but I found one important feature lacking: the ability to sort the tree using two keys.

I wanted `SyncURLs` to keep the tree sorted alphabetically by name with folders listed first, followed by bookmarks. The `CTreeCtrl` class provides two sort functions. One sorts tree items alphabetically by their labels, the other uses a callback function to sort based on the (optional) numeric data associated with each tree item. Unfortunately, the two methods cannot be combined. The name-sort function ignores the numeric data item and the callback sort only passes the numeric data to your callback function. There's no way for that function to determine which two items are being compared, so it can't locate their names to compare them.

To get around this, I created my own class, `CMyTree`, derived from `CTreeCtrl`. `CMyTree` contains a single override for the `InsertItem` member function. Note that there are several versions of this function, each of which takes

different numbers and types of parameters. `SyncURLs` uses only one version, however, so I only had to write one override.

The function takes a single parameter: a pointer to a `TV_INSERTSTRUCT` structure. The members of this structure (documented in VC's online help) contain all the information about the item to be inserted, such as its title text, image offsets, and numeric data. In particular, the `hInsertAfter` member indicates where in the tree the new item will be inserted. This flag can contain either a handle to an existing tree item (meaning the new item follows that item), `TVI_FIRST` (the new item is placed at the top of the list for its parent item), `TVI_LAST` (the new item is placed at the end of the list for its parent item), or `TVI_SORT` (the new item is inserted in sorted order by its name).

My override checks the value stored in the `hInsertAfter` member. If it contains any value other than `TVI_SORT`, my function passes the call on to the parent class function, `CTreeCtrl::InsertItem`. Otherwise, it scans through the tree to determine where to place the item based on whether or not it is a folder and its name. It determines the handle for the existing item that the new item should follow, places that handle in the `hInsertAfter` member, then passes the call on to the parent class. Whenever `SyncURLs` places a new item into the tree, it will thus be placed in the proper sort order.

`SyncURLs` was not complex to program, but the task it performs will be very welcome to many people. It does a simple thing, but it does it well: `SyncURLs` is compact, fast, and efficient. **PC**

Gregory A. Wolking, the author of SyncURLs, is the primary sysop of the ZNT:TIPS Forum on ZDNet/CompuServe and the PC Magazine Utilities discussion area on the Web.

Sheryl Canter is the editor of the Utilities column and a contributing editor of PC Magazine.

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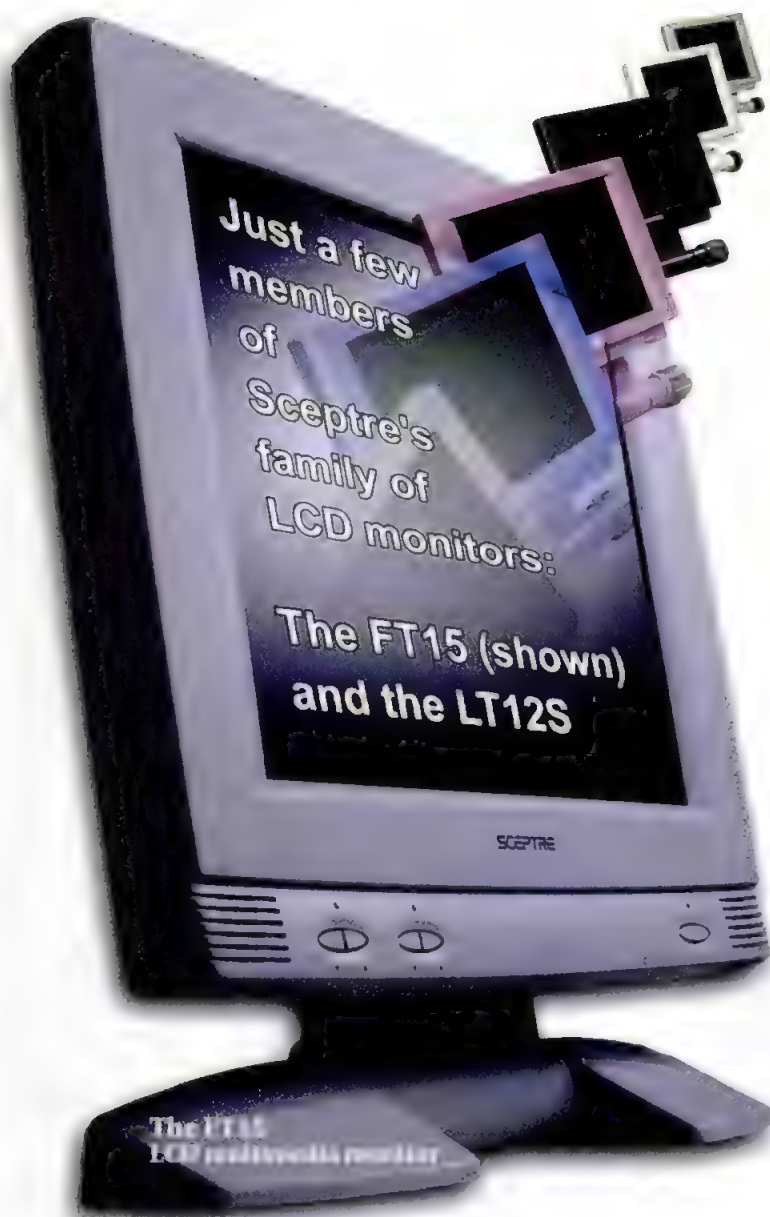
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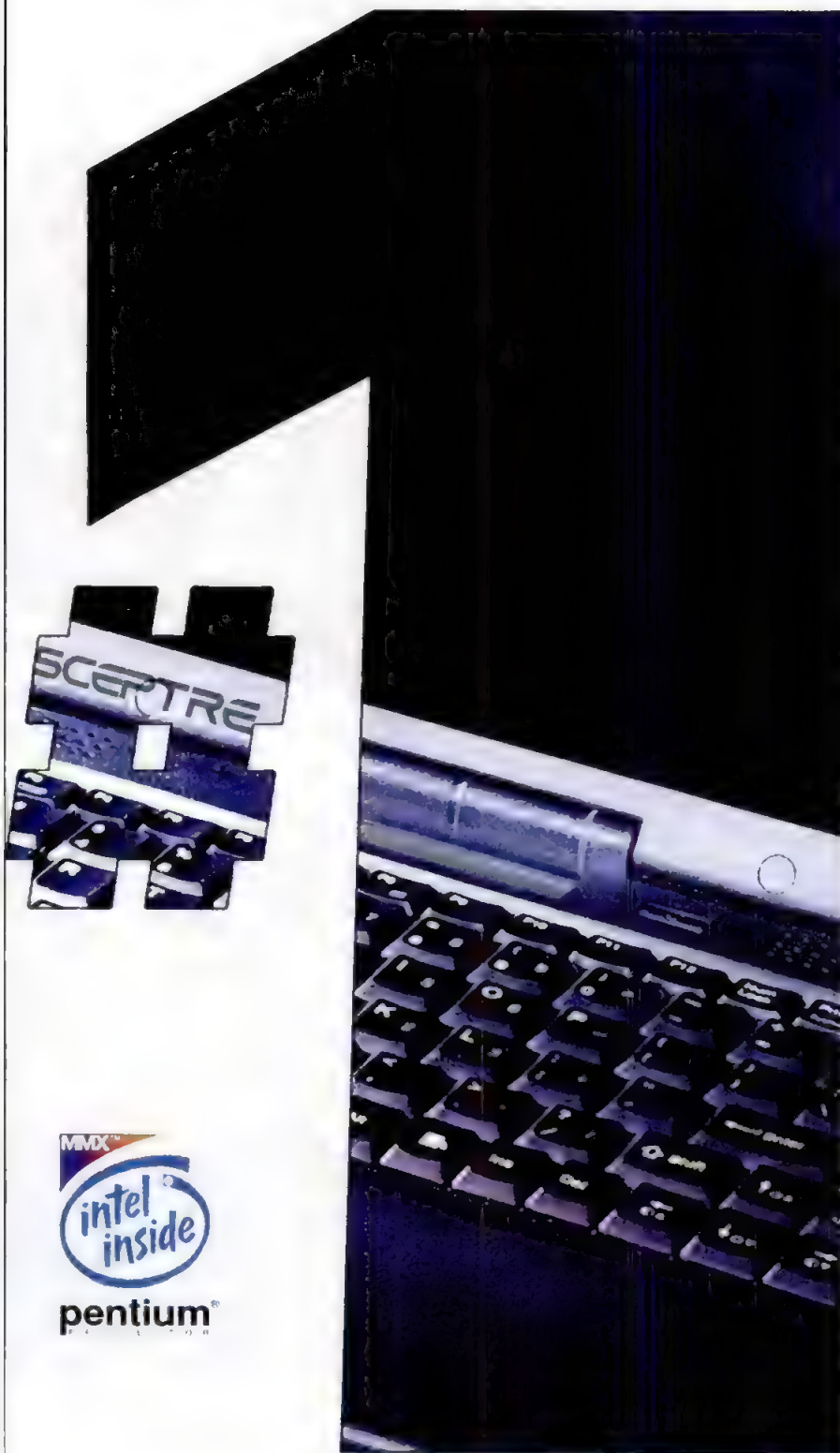
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User-to-User

BY NEIL J. RUBENKING

Use Wildcards to Change Directories in Windows NT

The Windows NT command prompt turns out to be more flexible when you change directories than the Windows 95 equivalent. Windows NT adds two incredibly useful features that ease navigation through directories with long names that are painful to type. First, it doesn't require directory names with spaces to be enclosed in quotes as Windows 95 does (for example, "cd program files" works just fine). Second, Windows NT allows the * and ? wildcards in destination directory names, so "cd p*" and "cd win??" work as well. You'll never type hard-to-reach characters again!

Unfortunately, if more than one directory matches a wildcard pattern, Windows NT switches to the first match it finds rather than allowing cycling between matches with the TAB key as NDOS and some Unix shells do.

TIMOTHY DYCK
via the Internet

PC MAGAZINE: Note that this tip refers to the command prompt as enhanced for Windows NT 4.0. If you try "cd p*" under Windows NT 3.x, you'll get an error message. The feature described above isn't the only way in which the Windows NT 4.0 command prompt's handling of wildcards is better than DOS's. Under DOS, the asterisk wildcard stands for zero or more characters, extending to the end of the filename or extension. Characters between an asterisk and the end of the filename or extension are ignored. In a Windows NT command prompt, the asterisk still stands for zero or more characters, but characters after the asterisk are valid. For example, if the current directory contains both "Microsoft Exchange" and "Microsoft Developer Network," you can type "CD m*e" or "CD Mi*Ex*" to choose the former, and "CD m*k" or "CD Mi*De*" to choose the latter.

The question mark wildcard still represents exactly one character. So, for example, the command "DIR *i?o*" will

list any files that contain the letter *i* followed by exactly two characters and the letter *o*. "Microsoft Exchange," "Windows NT," "WinWord," and "History" would all fit this template. You're not often likely to need a file template this complex, but if you do, Windows NT 4.0's command prompt will handle it.

Amazing Effects with Stretched Wallpaper

In Windows 95 with Plus!, the wallpaper can be stretched to fit the screen. This can produce some ugly results if the bitmap size doesn't match the screen resolution. The most undesirable effect occurs when you stretch a 256-color 640-by-480 bitmap to fit a 256-color 800-by-600 video mode. You can see this with Windows 95's 640-by-400 SET-URBMP.

The best solution is to switch to a 16- or 24-bit video mode and set a 24-bit picture as the wallpaper. Windows 95 automatically anti-aliases (smoothes) the bitmap when Font Smoothing (another Plus! feature) is turned on.

If your system can handle only 256-color mode, open the .BMP in Paint and save it as 24-bit. Now open the Stretch/

Plus! installed: First, turn on Font Smoothing and Stretch Wallpaper. Set the video mode to 24-bit if possible, otherwise 16-bit. Now open Paint and set image size to 5 by 3 pixels and magnification to 800 percent. Fill the bitmap with black, then paint colored pixels in the pattern shown in Figure 1. Save the file as a 24-bit bitmap, and choose Set As Wallpaper (Centered) from Paint's File menu. The effect is truly stunning on a 21-inch 1,600-by-1,200 24-bit system, and the bitmap itself is very small.

LUKE ALLEN
Albuquerque, New Mexico

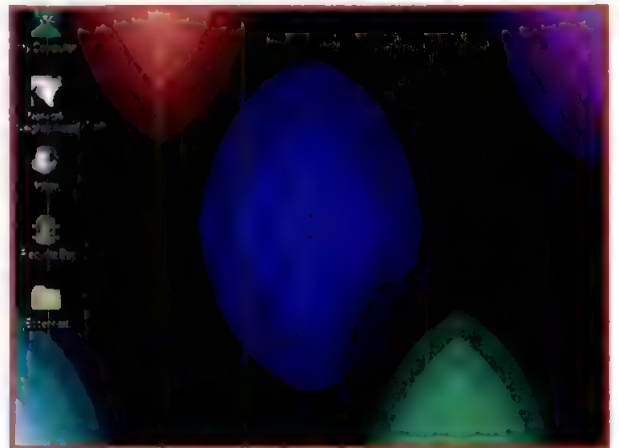


FIGURE 2: When the tiny bitmap in Figure 1 stretches to fill the screen, anti-aliasing makes each pixel blend gradually into its neighbors.



FIGURE 1: You can use this bitmap, just 15 pixels in size, to generate amazing wallpaper on a Windows 95 system with Plus! installed.

Skew dialog box and, in the text box for the percentage you want to stretch, type how much larger you want the bitmap. You might want a calculator, and Windows 95's comes in handy here; just use Alt-Tab to switch between the two. You will have to enter vertical and horizontal stretches separately. Now save and set the bitmap as wallpaper (centered) from inside Paint. Even in 256-color mode, you should have a more attractively stretched bitmap than you started with.

Here's something to try for a cool effect on a Windows 95 machine with

PC MAGAZINE: The effect of stretching that tiny bitmap to fill the screen with 24-bit anti-aliasing is truly staggering. Figure 2 shows the example 5-by-3-pixel bitmap stretched to 640 by 480. The anti-aliasing causes each pixel's color to fade gradually into the color of the adjacent pixels. Experiment with different minuscule bitmaps and see just what results you can come up with. Try other small sizes, possibly 4-by-3 or 8-by-6. Notice that darker-colored pixels don't "spread" as far.

As noted above, if your aim is simply to stretch an existing wallpaper in 256-color mode, you'll have to calculate the percentages by which to expand the image. To get the correct percentage, take the desired width or height, divide it by the actual width or height, and multiply by 100. Suppose you want to go from 640-by-480 to 800-by-600. Since 800 divided by 640 is 1.25, you'll stretch the width to 125 percent. And 600 divided by 480 is again 1.25, so you'll also stretch the height by 125 percent.

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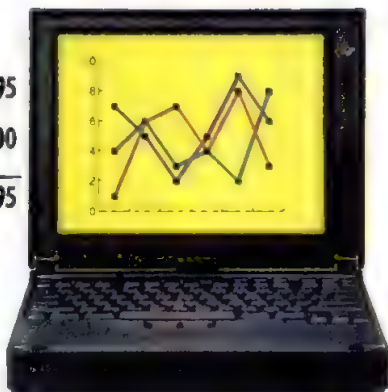


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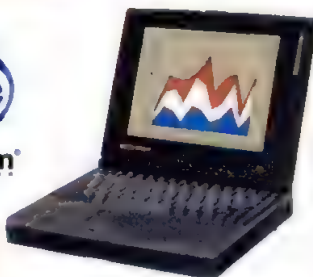
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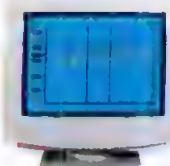
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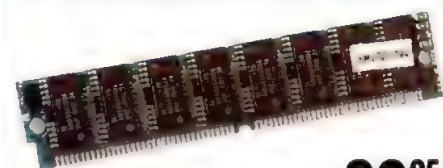
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A Fast Way to Calculate Cluster Waste

Users are often interested in finding out how much of the hard disk is being lost to cluster slack. Some use CHKDSK to find the cluster

may skew the average wasted space to more than half a cluster. The technique presented here yields a much more accurate measure.

Figure 3 shows an example. For a disk containing 8,039 files and 399 folders, with a cluster size of 8K, the standard calculation sug-

gests 33MB of wasted space. The actual amount of waste is quite a bit more, however. The right-hand window shows the nominal size of the files on drive C: to be 462MB, which would seem to be comfortably below the drive's 511MB capacity, but the left-hand window reveals that the actual space used is 504MB. So 42MB of space is wasted.

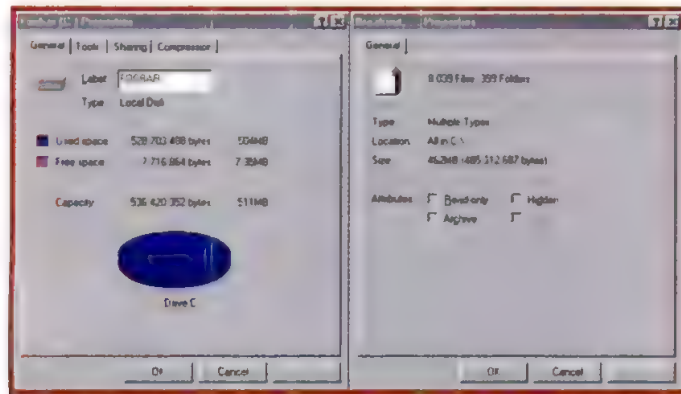


FIGURE 3: The left-hand window shows the actual space that is occupied by files and folders; the right-hand window shows the total of their defined sizes. The difference between the two figures is the amount of wasted disk space.

size and the number of files, then multiply the number of files by half the cluster size, but this method is often quite inaccurate. Although there are dedicated utilities that will give a better measure, Microsoft Windows 95 or Windows NT 4.0 users can get an accurate measure right from Explorer.

To find the amount of wasted space, first right-click on the drive icon in Explorer's left-hand tree window. Choose Properties from the pop-up menu. You'll see a pie graph of the disk, showing free and used space. The used space includes the size of files plus cluster waste; make a note of the number.

Now move to the right-hand pane in Explorer and press Ctrl-A to select all folders and files. Right-click the selection and again choose Properties. Wait a moment, as the actual size of all files on the disk is calculated. Note that this number is smaller than the one given in the left-hand pane; the difference between the two is an accurate measure of cluster waste.

ALAN ZISMAN
Vancouver, BC, Canada

PC MAGAZINE: First, a review. The FAT-based file system—used by DOS and supported by Windows 95, Windows NT, and OS/2—allocates space for files in whole clusters. Common wisdom holds that the average amount of space wasted in a file's partly filled last cluster is half a cluster. Thus the total amount of wasted space is estimated as the number of files and folders times one-half the cluster size. But this assumes that file sizes are evenly distributed; in practice, the prevalence of small files

Controlling the "From" Address in E-Mail

I discovered that if you change your name and e-mail address under Mail | Options | Server (in Microsoft Internet Mail or Netscape Mail), you can appear to be sending a message from someone else. The address and name in this area are taken when the new message is created, not when it's being sent. The only thing that seems to stick is the name of your mail server and mail ID number, which are meaningless to the average person. This can be dangerous if used the wrong way.

MARK WILLIAMS
Erie, Pennsylvania

PC MAGAZINE: It's possible that a rival at work could send a nastygram to the boss and, using this technique, put the blame on you. Don't worry—with a little help from your network administrator, you can use the mail server name and ID number to prove your innocence. And there are plenty of beneficial uses for this technique. I use it myself whenever a work-related e-mail arrives in my personal e-mail box. I could say in my response

that any further correspondence should go to my PC Magazine address, but most users just hit Reply. In such a situation I change the return address to my PC Magazine address, thereby moving any further conversation out of my personal e-mail box.

There are a number of services that offer "permanent e-mail addresses." When you use such a service, mail sent to the "permanent" address gets redirected to your actual e-mail address. If you switch to a different Internet service provider, you simply notify the service to change the redirection. However, for this system to work, your correspondents must use the permanent address. By changing the mail options as described here, you can arrange for your outgoing mail to carry that permanent address as the "From" address.

It's not uncommon for a small business to provide its employees with a company address, such as mark@mycompany.com, without actually giving the employee an Internet account. Instead, it redirects this address to the employee's personal e-mail account. Internet Explorer users can automate the process of swapping business and personal information in and out of the system. Launch a .reg file modeled after Figure 4, with business-related information, then run Internet Mail and answer any business messages. Close Internet Mail, launch a personal .reg file modeled after Figure 5, then run Internet Mail again and answer any personal messages. It's a bit awkward, but easier than typing the information into the Mail Options dialog every time.

REGEDIT4

```
[HKEY_CURRENT_USER\Software\Microsoft\Internet Mail
and News\Mail]
"Sender EMail"="john@smallcompany.com"
"Sender Name"="John Q. Public, Manager"
"Sender Organization"="Small Company, Inc."
```

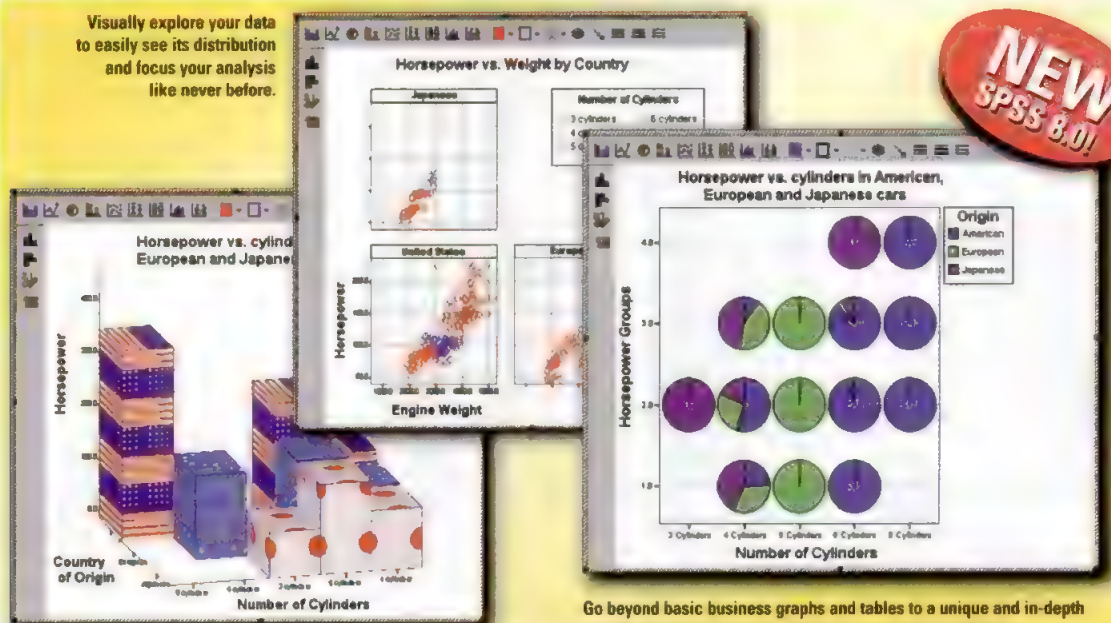
FIGURE 4: Create a file like this one, inserting your own business e-mail address, name, and company name.

REGEDIT4

```
[HKEY_CURRENT_USER\Software\Microsoft\Internet Mail
and News\Mail]
"Sender EMail"="jqpublic@personal.com"
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"Sender Organization"="John Q. Public"
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FIGURE 5: Create a file like this one using your own personal e-mail information.

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HARDWARE

Monitor Selection

I've narrowed my search for a new 17-inch monitor down to two—both with 16-inch viewable areas. One has a Trinitron screen with a 0.25-mm dot pitch and is capable of only 1,280-by-1,024 resolution at a maximum 60-Hz refresh rate. The other has a standard shadow mask with a 0.26-mm dot pitch, and it is capable of 1,600-by-1,200 resolution at 75 Hz. Which is more important: the first one's finer dot pitch and Trinitron tube, or the other's high resolution and flicker-free refresh rate?

RYAN PAUL
via the Internet

PC MAGAZINE: These specifications are a good place to start, but you need to understand what is being measured before you can adequately evaluate them. There are three separate issues: phosphor size, resolution, and refresh rate.

The phosphor size is important because it determines the smallest pixel that the screen can display. There are no hard-and-fast rules; the best place to start is to figure out the thinnest vertical white line that the monitors can display. Theoretically the Trinitron can produce a microscopically thin horizontal line, because it arranges the phosphors in vertical stripes. The only way to have it display a vertical white line, however, is to light up the stripes of all three phosphor colors. In this case, the minimum line thickness is 0.25 mm. Incidentally, this measurement is more accurately called the "stripe pitch," because it is the distance between two phosphor stripes of the same color.

The other monitor has a 0.26-mm dot pitch, with the phosphors arranged in triads. The triads overlap, and you can actually display a vertical white line as thin as 0.225 mm; the calculation requires a little right-triangle geometry. Basically, the calculation for the minimal vertical-line width is

$$\text{dot pitch} \times \sqrt{3 \div 2}$$

So as a matter of pure mathematics, the second monitor should produce a finer image than the first. But other factors are involved in image quality, such as convergence, beam focus, and image geometry.

The monitors' 16-inch viewable areas affect the next area of consideration: resolution. The

equivalent of 16 inches is about 406 mm. If the smallest vertical line for the second monitor is 0.225 mm, then the monitor can display 1,800 of them. Any more and image quality is likely to suffer. As a result, the 1,600-by-1,200 resolution is a reasonable maximum for this monitor, though it will probably look better at 1,280-by-1,024. The Trinitron monitor, on the other hand, can produce only 1,624 pixels in the viewable area, making it barely able to handle 1,600-by-1,200 resolution; 1,280-by-1,024 is certainly a better choice.

This brings us to the refresh rate. You should run your graphics card at the lowest refresh rate that eliminates flicker. With a 17-inch monitor, this rate may be higher than for a 14- or 15-inch monitor. That is because a larger image fills a greater portion of your field of vision, and human vision is more sensitive to motion in peripheral vision than to motion in the center of the field of view. If you're going to run the new monitor at 1,280-by-1,024 resolution, the second one may get the nod, because its 75-Hz refresh rate means it is less likely to produce noticeable flicker at that resolution. If you step down to 1,024-by-768 resolution, the Trinitron may well be able to handle a refresh rate rapid enough to eliminate flicker. If so, you'll have to resort to using some other factor—such as price, warranty, or the image's subjective appearance—to guide your choice.—*Alfred Poor*

OPERATING ENVIRONMENTS

Letting Animated-Cursor Files Be Their Own Icons

While I was modifying some file types on my laptop, my finger slipped on the touch pad, and I somehow lost the "animated cursor" file type. I like having this file type intact, because I can then see the cursor without opening the file. Now when I see an animated-cursor file in Windows Explorer, the "default" icon is beside it. Is there anything I can do short of reinstalling Windows 95 to get this file type back?

ANTON COLUN
via the Internet

PC MAGAZINE: Restoring the animated-cursor type to Explorer isn't difficult. Choose *Options* from Explorer's View menu, and click on the *File Types* tab. Create a new file type named Animated Cursor and fill in *ANI* as the associated extension. Press *OK* twice and you've re-created the file type. But that's only

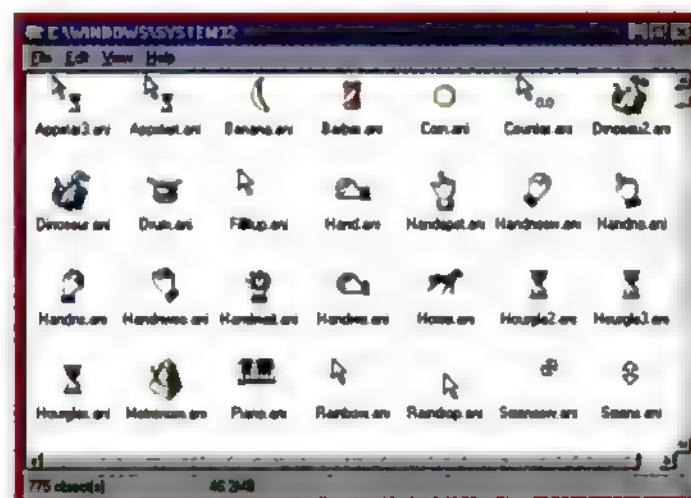


FIGURE 1: When the file type is correctly defined, the icon for each animated-cursor file is the cursor itself.

half the battle: You still have to restore the system's ability to display the cursor itself as the file's icon.

Run REGEDIT from the *Run* item on the Start menu, and double-click the *HKEY_CLASSES_ROOT* key to expand it. Click on the subkey named *.ani*, and note the internal type name in the Value column of the right-hand pane (it's normally *anifile*). Now right-click the subkey whose name matches that internal type name, and choose *New | Key* from the context menu that pops up. Change

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M. David Stone is a contributing editor and the coauthor of *Word for Windows Companion, Second Edition*.

the new key's name to `DefaultIcon` (no space). Double-click (*Default*) in the right-hand pane, and set its value to `%1` (no quotes). Close REGEDIT and restart your system. You've successfully restored your system's ability to display the animated-cursor file type!

With the same technique, you can make Windows 95 use an icon-size thumbnail of each bitmap file as that file's icon. The only differences are that you will start from the subkey named `.bmp` and that the `DefaultIcon` key will already exist under the "internal type name" subkey. Make a note of the `DefaultIcon` key's default value before you change it to `%1`: The thumbnail view is very helpful when you're choosing bitmap files, but it can sometimes slow down Explorer's display, so you'll need to know the old `DefaultIcon` value if you decide to change back.

—Neil J. Rubenking

WORD PROCESSING

Prevent Word 6 or 7 from Opening Multiple Instances

Microsoft Word 7 can open multiple instances of itself. While there are times when this can be useful, it can also cause problems. In particular, if you create a macro, AutoText entry, or other customization, you'll find that when you try to save the change to Normal.dot, Word won't let you. Instead, you'll get the message, "This file is in use by another application or user." Is there a program setting, command line switch, or Registry key value that would prevent Word 7 from being launched a second time?

FRED HEER
via the Internet

PC MAGAZINE: Word doesn't offer any built-in feature for preventing multiple instances, but the macro in Figure 2 will do the job for Word 6 or 7. The macro checks whether more than one instance of Word is running. If it finds more than one, it closes down the instance that you're running the macro from. Name the macro `AutoExec` and it will run whenever you start Word.

Before we look at the macro, it's worth mentioning another good reason for limiting Word to one instance. Some computer users in an office may be confused by multiple instances. It's not unusual for a relatively unsophisticated user to open Word, start working on a file, switch to another program, open another instance of Word, and wonder why Word insists that the file he or she wants to work with is in use by another user.

Worse, if the user tells Word to go ahead and open a copy of the file, some of the changes he or she made earlier may not show up, because the changed version wasn't saved to disk yet. And if the user works on the file, then saves it under another name, the result will be two versions of the same document sitting on the disk. The macro will help users avoid this problem, too. Here's how it works.

The `On Error` statement at the beginning of the macro ensures that if the macro runs into

```
On Error Goto bye
Instances = 0
Apps = AppCount() - 1
Dim winnames$(Apps)
AppGetNames winnames$()
For i = 0 To Apps
    If InStr(1, winnames$(i), "Microsoft Word") Then
        Instances = Instances + 1
    End If
    If Instances > 1 Then
        MsgBox "There is currently another instance of Word for Windows running. This instance will close.", 16
        AppClose()
        i = Apps
    End If
Next
bye:
```

FIGURE 2: This macro for Word 6 and Word 7 tests whether more than one instance of Word is running; if so, the macro closes the current instance.

an error condition it will jump to the label `Bye:` and exit gracefully.

The next four lines give the macro the information it needs. The first defines a variable called `Instances` and sets the value to 0. The next three work together to create a list of currently open applications. The first defines a variable called `Apps` and uses the function `AppCount` to get a count of the number of applications running. The next line uses the `Dim` command to define an array variable, called `winnames$`, that's large enough to hold the names for as many applications as `AppCount` has determined are running. The `AppGetNames` line, finally, fills the array with the names of the currently open applications.

Most of the work the macro does is in the `For...Next` loop, which repeats once for each entry in the `winnames$` array—which is to say, once for each application that's running.

The first `If...End If` block tests the application name for each iteration of the loop. If the name is "Microsoft Word," the macro increases the count of `Instances` by 1. The second `If...End If` block tests the current value

of `Instances`. As long as the value is 0 or 1, the macro jumps to the `End If` line. If the value of `Instances` is 2, however, the macro displays a dialog telling you that another instance is running, and closes the current instance with the `AppClose` command.

You'll find the text of this macro on PC Magazine Online as `Oneins.txt`. To create the macro, choose *Tools | Macro*, enter the name `AutoExec`, and choose *Create*. Word will open a macro-editing window with `Sub MAIN` and `End Sub` statements already entered. Add

the text from Figure 2 between these statements. Choose *File | Close* and answer *Yes* when Word asks if you want to keep the changes to the macro. Then close Word and answer *Yes* if Word asks whether to save the changes to `Normal.dot`. Note that if you already have an `AutoExec` macro, you can add this code to it, but the details will depend on what's already in the macro.

To test the macro, load Word. The first instance should load as usual. When you try opening a second instance, you should get a message that another instance is running. When you choose

OK in the message box, the second instance should close.

Note that with Word 6 you will have to make sure the *Tip of the Day* feature is off, or else you'll get a message that you can't close Word because a dialog box is active. To turn the feature off, simply remove the check from the *Show Tips at Startup* check box in the *Tip of the Day* dialog. If you occasionally do want a second instance, you can prevent the `AutoExec` macro from running by holding the *Shift* key down when you start Word.

—M. David Stone

SPREADSHEETS

Left-Padding with Zeros

I need a way to convert a column of numbers in an Excel file from currency to nine-digit numbers with no decimal points and with leading zeros. Then I need to save the file as a CSV ASCII file that will keep the leading zeros.

The file contains about 2,000 lines of check data and the Amount column contains (for example) \$5,529.26, which I need to convert to

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#94278	380D	150MHz w/MMX*	16MB	2.1GB	8X	12.1" TFT	6.9	'2,499	'100
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PCTech Ask Our Advisors

000552926. I am currently running macros in Lotus 1-2-3 (Version 3.4) and then opening the file in Excel so that I can save it as a .CSV ASCII file. Everything I have tried in Excel to convert the Amount column appears to work, but the program drops the leading zeros as soon as I save as .CSV.

Any suggestions?

PATTY MCQUAID
Philadelphia, Pennsylvania

PC MAGAZINE: When Excel imports text strings that look like numbers, it tries to convert them to numbers. If the text strings happen to contain leading zeros, Excel dumps them. This behavior may be useful for most people, but it's clearly not ideal for you.

You should be able to import your raw data from 1-2-3 into Excel and even run your 1-2-3 macro there. Then you could put the processed values on a fresh sheet and save the sheet as a CSV file—without losing those leading zeros. If for any reason the 1-2-3 macro doesn't perform as expected in Excel, the following formula will convert a value in A1 to a nine-character string padded with the necessary number of zeros:

```
=REPT("0",9-LEN(100*FIXED(A1,2,1)))  
&100*FIXED(A1,2,1)
```

Plant the formula on a clean worksheet, modify the A1 reference, replicate as needed, and save as a .CSV file.—Craig Stinson

An Excel CD-ROM Bug

I recently ran into the following bug in Excel 97:

1. Make sure you've closed everything, because you're about to crash.
2. Make sure your CD-ROM drive is empty.
3. Open Excel and any workbook.
4. Minimize Excel.
5. Press the Eject button on your CD-ROM drive.

This causes Excel to crash on every system in our company.

ANTHONY FARMER
San Rafael, California

PC MAGAZINE: A spokesperson for Microsoft says this is a known problem affecting systems with particular CD-ROM drives: the Panasonic CR-584B (12X, ATAPI/IDE), the Toshiba 5702B (12X, ATAPI/IDE), and the Toshiba XM1502B (10X). The problem has been solved, according to Microsoft, by the Office 97 Service Release 1, which you can download from www.microsoft.com/Office/Office97/ServiceRelease.—Craig Stinson

DATABASES

Sending Standalone Access Reports

My boss wants to e-mail some Microsoft Access reports to correspondents who do not have Access, and because he may have to do it a lot, he wants it to be a simple procedure. The reports aren't huge, only a page or two. Is there any way to send a report without having to send the whole Access file?

GEORGE SPARK-STAHLE
Albany, Oregon

PC MAGAZINE: If all of your recipients use the same printer and have the same printer fonts installed as you do, you could theoretically use your printer driver's print-to-file feature to output the report to a disk file (such as Report.prn). You could then send the disk file to your e-mail recipients as an attachment, and they could then print the report using the DOS command copy Report.prn prn: to copy the report file to the printer. However, because that technique limits everyone to the same hardware environment, and because the .prn files are likely to be somewhere between large and huge, the solution is not ideal.

If you're using Microsoft Access 97, a better solution is available after you install the Microsoft Access Service Release 1 update. This update adds support for a new feature called a *report snapshot*—a file that contains a high-fidelity copy of each page of a Microsoft Access report. The report snapshot preserves the two-dimensional layout, graphics, and other embedded objects of the report, so you can send an .SNP file via e-mail or on disk to correspondents without having to send the entire database. The recipients can view, print, or e-mail the report using the new Snapshot Viewer (see Figure 3).

The idea is to let you distribute and publish report snapshots using either e-mail or a Web page. That way you don't have to print, photocopy, and distribute hard-copy reports, and your users can easily view or print only the report pages they need. The Snapshot Viewer comes in a 1.7MB self-extracting compressed file, which expands to 2.8MB.

To create a report snapshot, select the Database window, choose the *Reports* tab, and select the name of the report you want to publish. Then select the File menu, choose *Save As/Export*, select *To an External File or*

Database, and choose *OK*. Then enter the filename for the report in the *Save As* dialog, select *Snapshot Format (.snp)* in the *Save As Type* box, and choose *Export*. Once the file is exported, you can send it via e-mail or make it available for viewing through a Web page on your Web site. The Snapshot Viewer includes an ActiveX control that can be activated

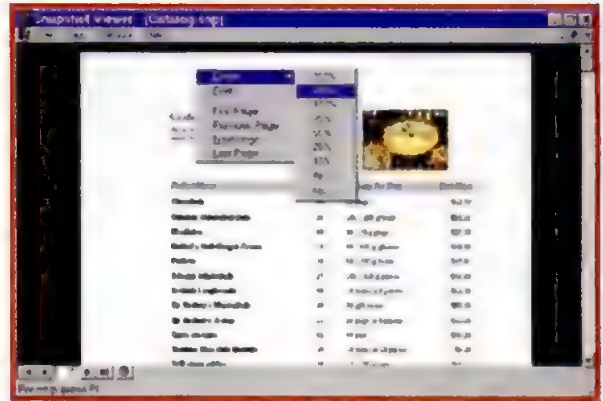


FIGURE 3: The Microsoft Access Snapshot Viewer lets you view, print, publish, or e-mail Microsoft Access reports in .SNP files.

when you click on a Web link to open the report in a Snapshot Viewer window.

The Snapshot Viewer has one important limitation. Report snapshot files can be opened and viewed only with Windows 95 or Windows NT.

The Microsoft Access 97 Service Release 1 update is part of the Microsoft Office 97 Service Release 1 update, which can be downloaded from www.microsoft.com/office/office97/servicerelease. The Access Snapshot Viewer can be downloaded from www.microsoft.com/officefreestuff.—Sal Ricciardi

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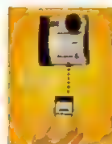
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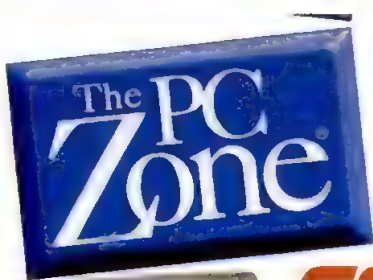
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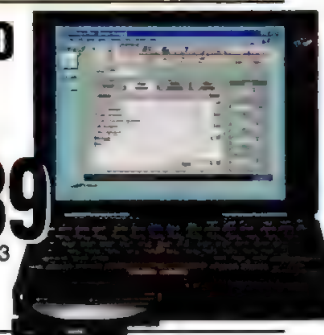
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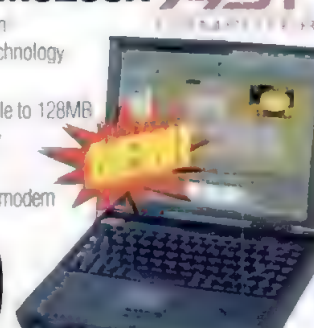


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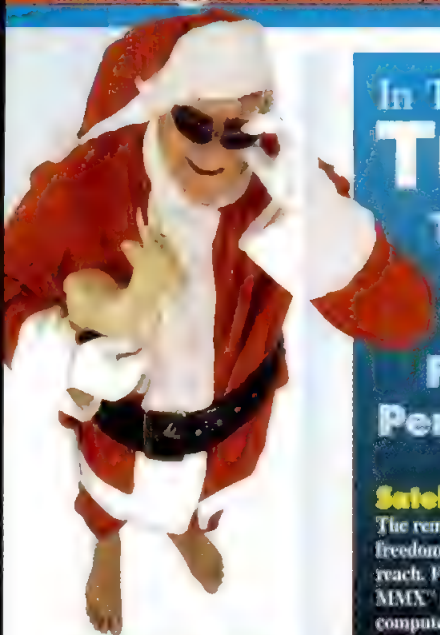
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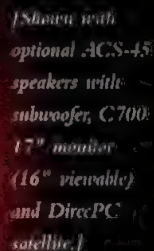
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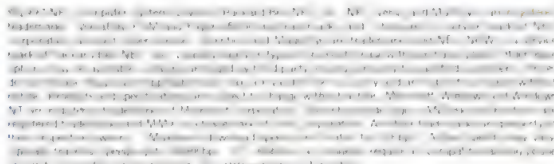
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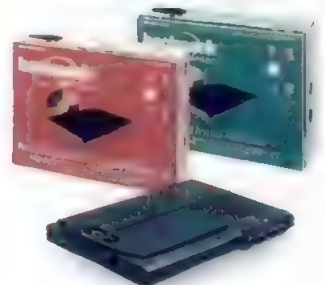
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2000MB	5200	Western Digital	AC22000	\$179
2500MB	5200	Micropos	MC4525A	\$180
285MB	4500	Seagate	ST32531A	\$169
2859MB	5200	Western Digital	AC22800	\$188
3166MB	5200	Western Digital	AC33100	\$205
4000MB	5200	Western Digital	AC34000	\$231
4000MB	5200	Micropos	MC4540A	\$225
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4550MB	7200	Seagate	ST34555N	\$349
4550MB	7200	Seagate	ST34572N	\$349
4550MB	7200	Quantum	VK34550S	\$349
4550MB	7200	Quantum	XP34550S	\$519
4850MB	10000	Seagate	ST34810N	\$599
6484MB	5400	Quantum	FB36480S	\$399
9100MB	7200	Fujitsu	M2949S	\$825
9100MB	7200	Quantum	XP39100S	\$799
9100MB	7200	Seagate	ST39117N	\$825
9100MB	10000	Seagate	ST39117N	\$999
18000MB	7200	IBM	1DGH518Z	\$1899
23300MB	5400	Seagate	ST423451N	\$1679

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4550MB	7200	Quantum	VK34550W	\$459
4550MB	7200	Quantum	XP34550W	\$519
4850MB	10000	Seagate	ST34810W	\$629
9100MB	7200	Fujitsu	M2949W	\$845
9100MB	7200	Quantum	XP39100W	\$799
9100MB	7200	Seagate	ST39117W	\$869
9100MB	10000	Seagate	ST39117W	\$1029
18000MB	7200	IBM	1DGH518W	\$1899
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2160MB	5400	Fujitsu	MP3021A	\$161
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3227MB	4500	Seagate	ST33232A	\$195
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24X	Pioneer	DRX24X	75	\$91
24X	Mitsumi	CRMCFX24X	90	\$89
24X	Toshiba	XM6102B	85	\$89
32X	Teac	CD532E	84	\$110

IDE CD CHANGERS

Speed	Brand	Model	# Disks	Int
6X	NEC	CD44X6	4	\$79
8X	NEC	CD44X8	4	\$89
12X	Panasonic	SQTC512N	5	\$265
16X	Nakamichi	MJS16A	5	\$149

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Speed	Brand	Model	ms	Int
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12X	Plexstor	PX12XScaddy	105	\$209
16X	NEC	CDR1610	100	\$115
20X	Plexstor	PK20TS	95	\$199
24X	NEC	CDR1810	85	\$145
32X	Teac	CD532S	85	\$145
32X	Plexstor	tray or caddy	85	\$145

SCSI CD CHANGERS

Speed	Brand	Model	# Disks	Price
16X	Nakamichi	MJS16	5	\$239

SCSI CD TOWERS

Speed	Brand	Model	4 Drive	7 Drive
16X	NEC	100ms	\$599	\$1079
20X	Plexstor	95ms	\$1139	\$2019
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Ethernet 7 CD TOWERS

Speed	Brand	Model	10-T	100-T
16X	NEC	100ms	\$1829	\$2029
20X	Plexstor	95ms	\$2769	\$3969
24X	NEC	85ms	\$2149	\$2349

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32Gig TR3 12000000 Parallel ver	\$189
60G TR4 22800000 IDE/SCSI	\$285/\$339
SONY	
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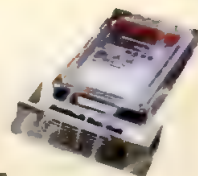
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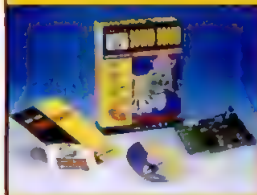
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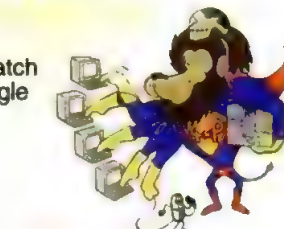
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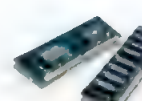
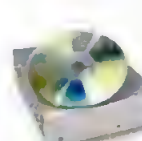
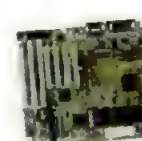
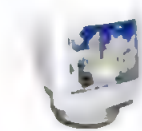
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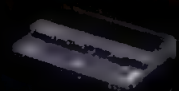
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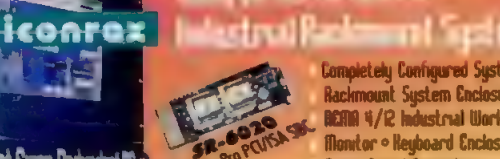
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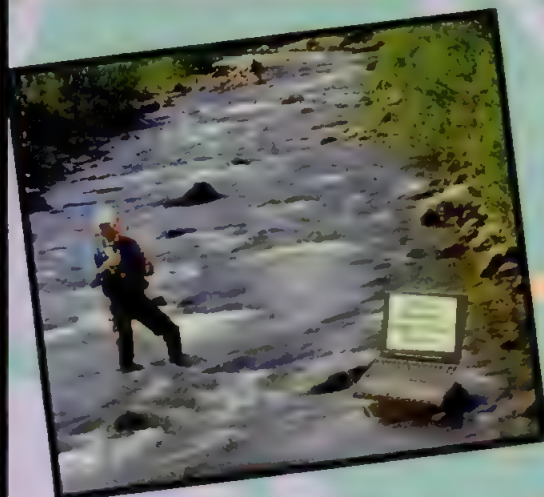
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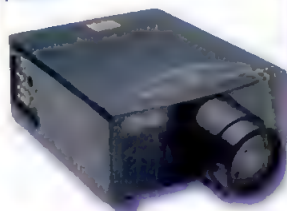
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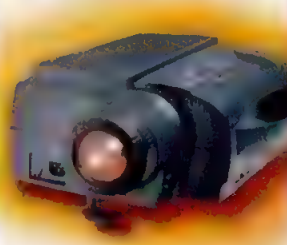
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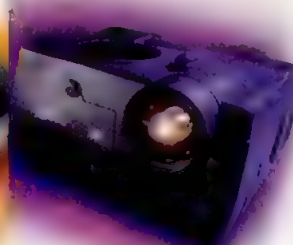
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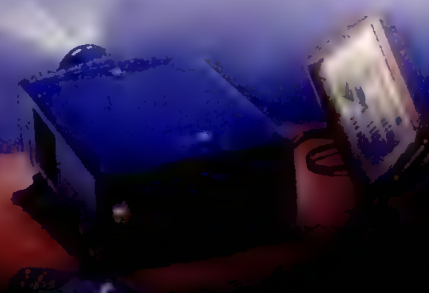
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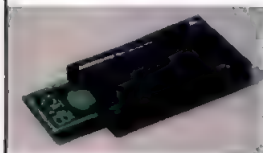
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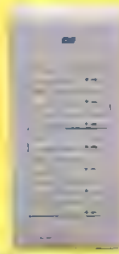
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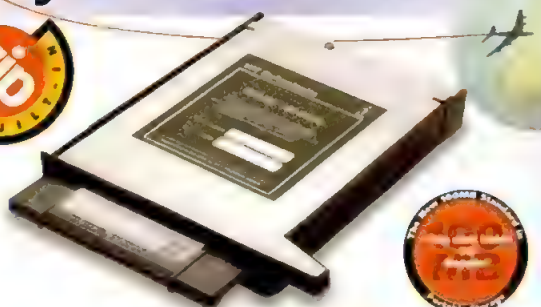


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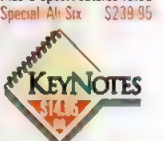
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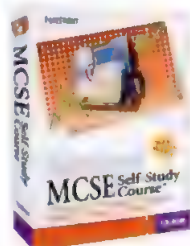


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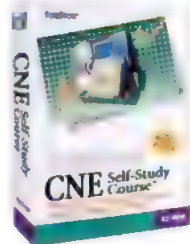
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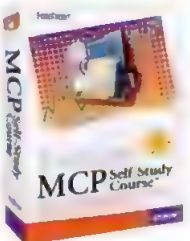
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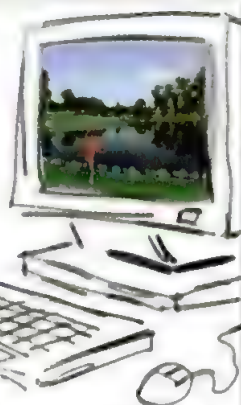
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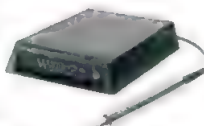
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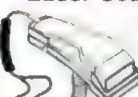
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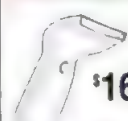


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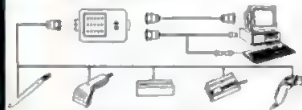
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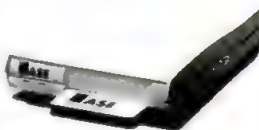
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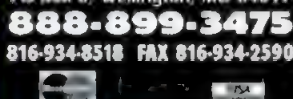
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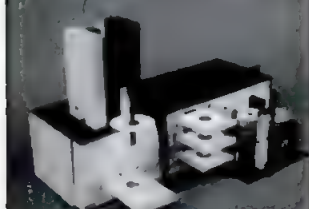
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Following up on the story and the incredible popularity of Myst, Red Orb Entertainment finally releases Riven.

Riven: The Sequel to Myst

Unless you've only recently returned from a remote tropical island, you've probably heard of Myst. The now-ubiquitous adventure game has sold more than 4 million copies and has attracted legions of loyal followers. And now the three-year wait of those loyal legions is at an end: The sequel to Myst is out. Riven, appropriately subtitled "The Sequel to Myst," is finally here. While it irks us to say that any computer game is worth such a long wait, we must admit that Riven, from Broderbund Software's Red Orb Entertainment division, is everything that Myst fans have been hoping for. Even non-Myst fans who enjoy



slow-paced, absorbing games will find plenty to appreciate.

Riven runs on Windows 95 and Macintosh computers. Under Windows 95, it requires at least a Pentium/100 with 16MB of RAM, 16-bit color, and 75MB of hard disk space.

If you managed to finish the original Myst, you'll remember that Atrus, the creator of the Myst world, met and recruited you. Riven picks up the story

there, with Atrus telling you of a land called Riven where his father, Gehn, has been stranded for the past 33 years. Atrus also suspects that his wife is trapped somewhere on Riven, and he asks you to locate and rescue her. Then you're plopped down on Riven, left to explore and learn about the place and its inhabitants.

Many computer game sequels are little more than add-on missions, but Riven is a true sequel. Although the graphics engine and the interface will be familiar to Myst fans, everything else is a step up. Riven uses full-motion video that truly complements the game play, gorgeous scenery that makes Myst's artwork look like Space Invaders, and game play that's a notch above the original.

Unlike Myst, which had you wandering about a series of nicely rendered rooms and encountering haphazard puzzles, Riven's puzzles are integrated into the story. They are tougher to solve, but at least they are related to what's going on around them.

Game play in Riven is less linear than it is in Myst. You can explore more areas and do far more than you could before. And Riven teems with life, from the indigenous her-

mits who scamper away to the wildlife that scurries about everywhere you turn.

Riven is not flawless, however.

We hated all the disk swapping.

The game comes on six CDs and begs to be ported to DVD, which may happen in 1998. While solving a few of the game's puzzles, we got the feeling we'd been there and done that before in other games. But when all is said and done, Riven is a very good adventure game. Those who spend their nights with faster-paced fare, such as Hexen II, will fall asleep before the opening video sequence ends. But those who enjoyed the original will like this sequel just as much if not more.—Shane Mooney



INSIDE

HOUSE OF CARDS

Create greeting cards with a store-bought look from your PC. *Page 328.*



▲ SPY WHO LOVED YOU

An utterly good time, from Humongous Entertainment. *Page 340.*

DARK REIGNS SUPREME

An army strategy game wreaks havoc with the competition. *Page 340.*

BUILD TO IMPRESS

Construct an empire in this 19th-century-based strategy game. *Page 343.*



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Great Greetings

When PCs started spitting out greeting cards back in the eighties, it was somewhat of a novelty to create your own. But the quality didn't fool anyone. The cards virtually screamed, "I made this myself!"

What a difference a decade makes. A wave of new greeting card programs (which also create things like business cards and labels) will make your screen the electronic equivalent of a Hallmark store. They let you select from thousands of designs, even for rather obscure occasions, and choose the sentiment. If you don't like the multitude of verses available, you can edit them or write your own. Also, you can use your own graphics and photo files. Microsoft's offering even lets you send multimedia accolades.

These programs do a superb job of printing greetings in color and delivering them with little trouble via e-mail. And just to make sure you no longer have any legitimate excuses for missing an important occasion, they let you set up a reminder book and address file.

Each of the companies here offers at least one other greeting card program; we looked only at the most recent.

Greetings Workshop Deluxe



The product of a collaboration between Hallmark Greetings and Microsoft, Greetings Workshop Deluxe (for Windows 95, \$49.95 list), might best be described as "Microsoft Word meets the Magic School Bus." Its design blends a cartoonish

look and feel with application-style dialog boxes and processes. But the output possibilities are vast, ranging from simple cards to complex multimedia projects spread over two CDs.

When you sign in, you identify yourself as a beginning, intermediate, or advanced computer user, and the program adjusts its help tools to accommodate you. You can choose among more than

and video clips. You can import your own graphics in formats such as .BMP and WMF.

Rocky, an animated dog, follows you from screen to screen to offer instructions and options. Once you've selected a project type by clicking on a graphic on the opening screen, you can select from the designs and messages supplied for your project or work on your own, even editing the boilerplate

sands of options prove insufficient, you can launch the online Greetings Workshop from your browser and choose from more there.

Once you've completed your designs, you have numerous options. You can print your project and send it through the mail, e-mail it, or send it to the Greetings Workshop Post Office on the Web, where recipients can go to view it.



CreataCard Gold

Combine one of the country's biggest greeting card companies, American Greetings, with one of the best graphics software publishers, Micrografix, and you get a program that bests its competitors in some areas. CreataCard Gold (for Windows 3.1/95, \$49.95) has a colorful interface and a respectable variety of projects and designs, throwing in an address book/calendar and Creative Workshop—a palette for building your own designs.

CreataCard Gold lets you design greeting cards, announcements, stationery, labels, envelopes, gift tags, invitations, signs, awards and certificates, and business cards. It comes with more than 4,000 templates, 2,500 images, and 3,000 verses. You can obtain additional content by calling the company for a code num-

12,000 projects (including stationery, posters, stickers, vertical banners, invitations, announcements, and cards), over 4,500 canned messages, more than 15,000 graphics, over 1,000 photos, and sound

message if you like. This step-by-step process works well, though unfortunately the design templates aren't big and readable enough to show how the card will look before you preview it. Should the thou-

Greeting Card Software

YES YES NO

List price

Special projects

Make cards from scratch

User can edit graphics/photos*

Multimedia projects

Output options

Windows 3.1 / 95

CreataCard Gold
(Micrografix/American Greetings)

\$49.95

Announcements, awards, business cards, certificates, envelopes, labels, gift tags, stationery

✓

✓

✓

Print, e-mail, printing/delivery by American Greetings

✓

Greetings Workshop
(Microsoft)

\$49.95

Announcements, awards, banners, calendars, posters, signs and flyers, stationery, stickers

✓

✓

✓

Print, e-mail, Web-based virtual post office

✓

Signature Greetings
(Broderbund Printshop)

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Envelopes, invitations, photo frames, postcards

✓

✓

✓

Print, e-mail

✓

*Rotate, resize, or flip images, for example

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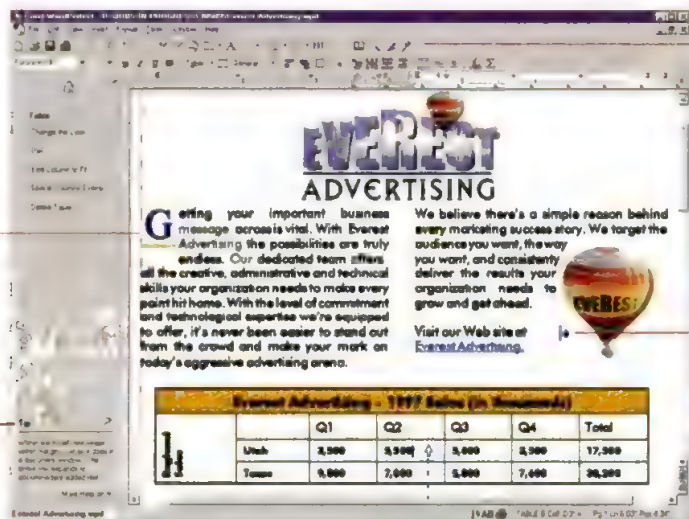
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InfoWorld
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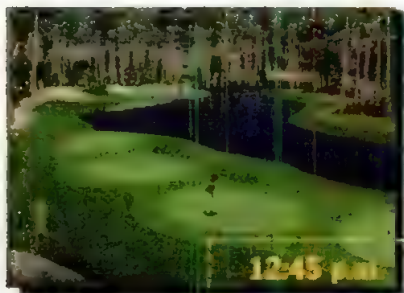
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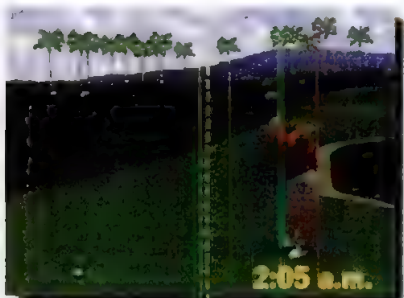
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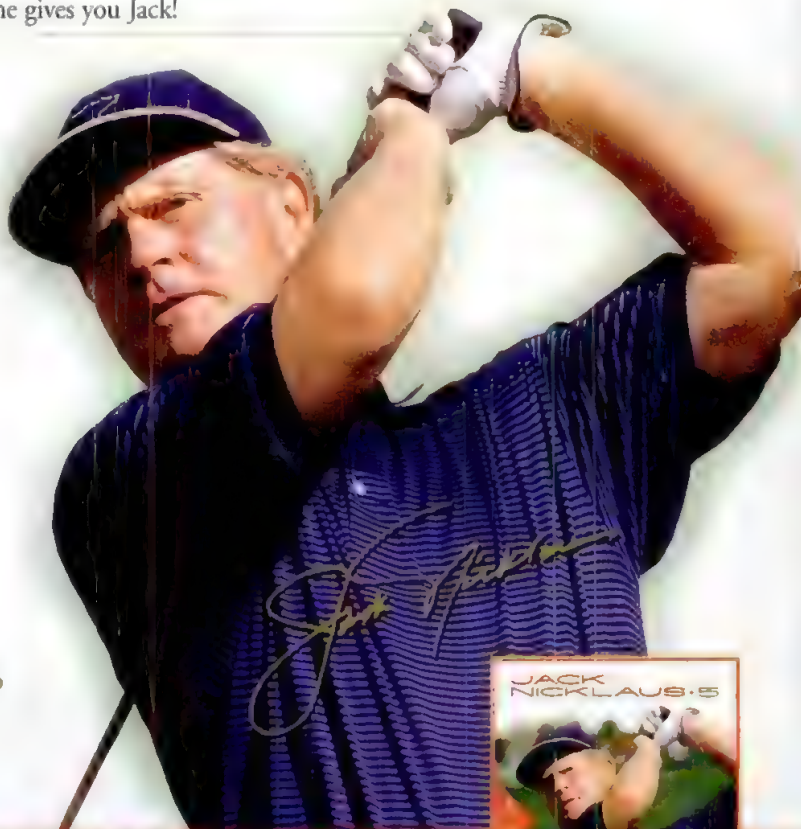


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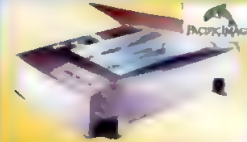
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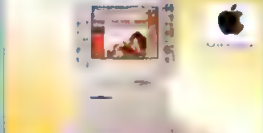
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ber with which to unlock it on your CD (at extra cost) or by visiting CreaCard Online (where some content is free).

The opening screen looks like a greeting card shop. In addition to the project types and other access graphics, you'll find a graphic labeled "Find a Card." This nifty little utility asks a series of questions about the occasion, the card's recipient, and the type of sentiment you want to express, then suggests several designs.

You can also browse through the designs, choosing from cards for an impressive array of occasions. The holiday section is especially varied, providing cards for common holidays and also for lesser-known occasions, such as Kwanza and Hari Raya.

Unlike its competitors,

Cards on The Side

If you want to make posters, flyers, and banners, in addition to some greeting cards, check out the desktop publishing and all-in-one creativity software we review in "Start the Presses" (November 4, 1997).

Mindscape's PrintMaster Gold Deluxe (\$50 street) was our Editors' Choice, a winner in terms of the quality of its preformatted designs. Broderbund Software's The Print Shop Publishing Suite (\$35 street) is a good choice for novices and youngsters.

Roughly equal are Corel's Print & Photo House 2.0 (\$69.95 list), IMSI's Master-Publisher (\$30 street), and Sierra On-Line's Print Artist 4.0 (\$34.95 list). Also consider Microsoft Publisher 97 (\$75 street), the premier personal desktop publishing program.



CreaCard Gold provides a helpful, readable preview of your card right after you've selected it. Like the others, the title lets you edit the text (though on the card, not in an editing box) and print it or send it via e-mail. Electronically transmitted cards appear as .EXE files in attachments.

Users wanting greater creative control can visit Creative Workshop, which provides drawing tools and customizable verses, clip art, and photos.

The Print Shop Signature Greetings

Broderbund's The Print Shop was one of the original PC-based printing-press programs in the mid-eighties, and the company has continued to develop its family of specialized printing products. The Print Shop Signature Greetings (for Windows 95, \$29.95) designs and prints personal projects: online greetings, mailing labels, address books, photo frames, greeting cards, envelopes, and postcards. Although it's not as complex or option-packed as Microsoft's Greetings Workshop Deluxe, it's a good choice for people who don't need the additional

templates and graphics, and it costs about half as much.

Signature Greetings has more than 5,000 boilerplate designs and 2,000 messages. You can edit verses or write your own, and you can import graphics and photos in popular formats. Additional graphics are available from the Broderbund Web site.

The opening screen could not be simpler or cleaner. You select a type of project by clicking on the appropriate graphic, then move to the theme selection screen. Once

you've chosen a theme and, if necessary, a subtheme—for instance, Holidays, then Christmas—you can preview the various selections. Choose one and click on Select and you're on the Personalization screen. Buttons at the bottom of each screen let you move back, return to the Projects screen, or see a Help screen.

Since you can't view the entire card at once, Signature Greetings supplies buttons to let you toggle between the front and back. Double-click on the verse and up pops an editing screen, with tools such as a spell-checker, a thesaurus, a list merge (for mass mailings), and a preview option. You can use the program's address book to track frequently used addresses, and you can create matching labels and envelopes for cards.

Once you're satisfied with your design, you can print it or use the online-greetings option. The creation process is the same, but when you click on Send, an e-mail envelope box opens and lets you address and dispatch the greeting. It arrives as a JPEG attachment, with an annoying advertisement for The Print Shop in the body of the message.—Kathy Yakal



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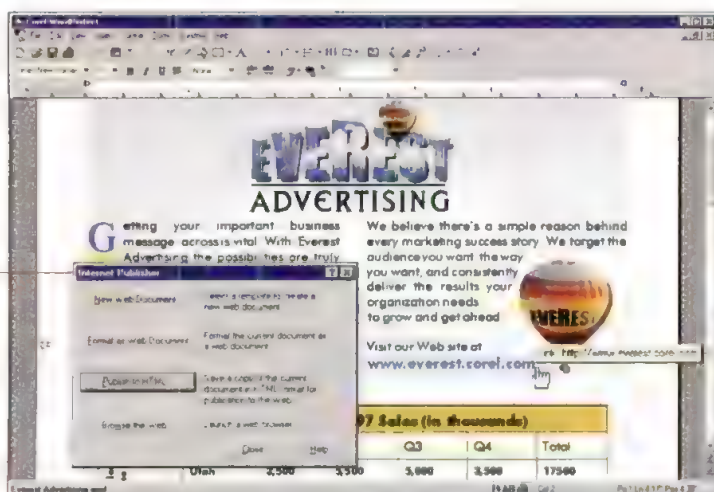
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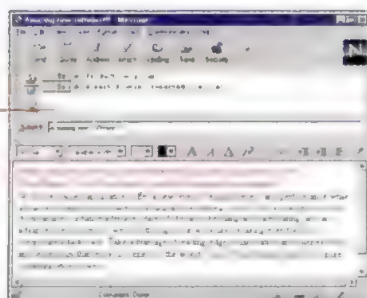
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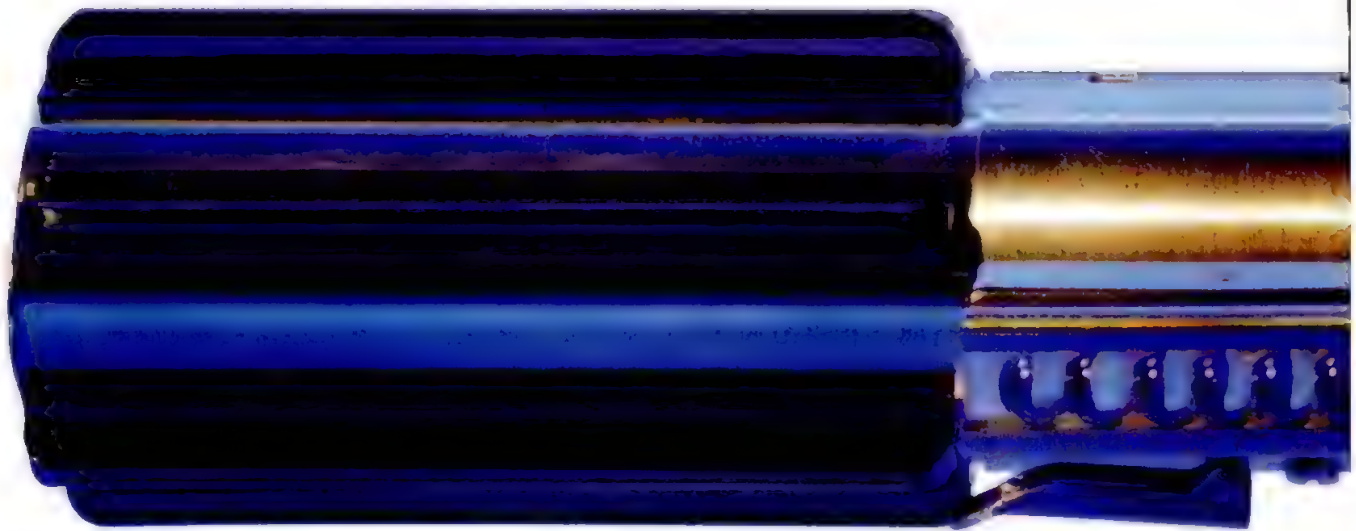
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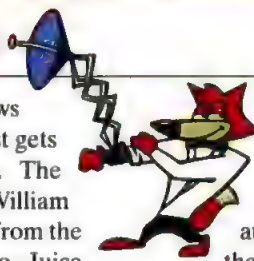


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The Name's Fox. Spy Fox.

Humongous Entertainment's newest game is shaken, not stirred.

Spy Fox in "Dry Cereal"

If James Bond were an animal, what would he be? A fox, of course, in early eighties lingo. Humongous Entertainment features just that fox in its newest game, *Spy Fox in "Dry Cereal"*. The new hero is a dandy in a white dinner jacket and black bow tie. In *Monkey Penny* and *Professor Quack*, he has just the support staff you'd expect of a master spy. And the adventure is pure

Humongous Entertainment.

Evil William the Kid's five-part master plan for worldwide domination starts with captur-

ing all the dairy cows in the world and just gets worse from there. The game opens after William has stolen the milk from the Amalgamated Moo Juice factory and kidnapped the company's president, Howard Hugh Heffer Udderly III. Spy Fox is sent to the island of Acidophilus to rescue Mr. Udderly

and stop William from finishing his dastardly plan.

This likable adventure continues the company's tradition of funny characters and oodles of clickable items. Aimed at children aged 5 to 10, the game is more sophisticated and requires more skill than did Humongous's *Paja-*

ma Sam, *Putt-Putt*, or *Freddi Fish* titles.

The older target audience is evident in the game's length. It's

long—maybe too long. Thankfully, the F1 key gives access to valuable clues, and *Spy Fox's* watch offers a save function.

The key to the game is to backtrack often and click wherever you get a white arrow; you never know what crazy thing will come in handy! (You should also be fairly skilled at *Go Fish*.)

Like most of the company's titles, this game can be played on PCs running Windows (3.x or 95) and on Macintoshes running System 7.0 or higher.

Adventures and mysteries are great ways to stimulate young minds. Bring home *Spy Fox* and you and your children won't be disappointed. —*Mary E. Behr*



Super Real-Time Strategy

A state-of-the-art gaming experience that can be simple or complex.

Dark Reign

When the waters recede from the initial flood of real-time strategy games, two titles will remain on high ground: *Dark Reign* and *Total Annihilation*. Like the competition, they take their cue from the classic *Dune II* model of building a base, creating an army, and crushing the enemy. But these games add enough innovations to lift themselves above the herd. *Dark Reign*, in particular, creates a gaming experience that is familiar in its simplicity yet quite complex and will appeal to those who want to delve deeper.

As one would expect from Activision, production values

in *Dark Reign* are state-of-the-art. Video sequences are lavish, terrain graphics intricately textured and shaded, and explosions screen-filling, all of which should run fine on a Pentium/90 with 16MB of RAM and a 1MB PCI or VESA local-bus video card. You need a quadruple-speed CD-ROM drive to play the movies, but 2X is enough to play the Windows 95 native game.

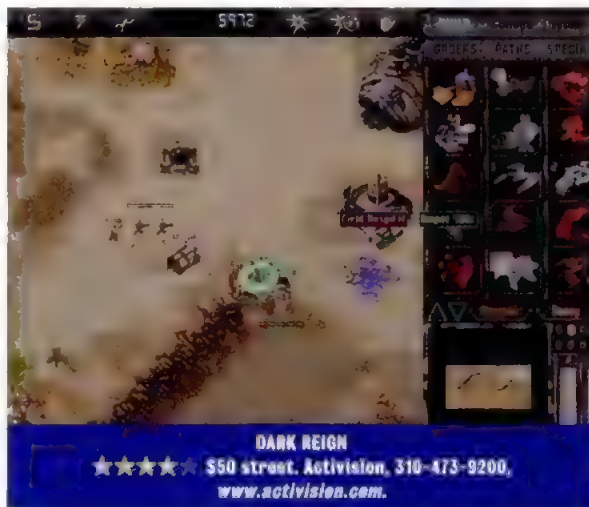
At first glance, game play seems

to follow conventional patterns of placing structures, building combat units, harvesting water and "taelon" (the sources of money and power), and then sallying forth to deal some death to the infidels. But a trip through the near-perfect four-part tutorial shows the depth lying beneath the interface.

In *Dark Reign*, each unit

can be grouped into one of ten different armies and given complex sets of orders. Most impressive, unit behavior can be adjusted to fine-tune attacks: You can order a unit to retreat when it suffers a specified amount of damage, move in formation, attack without leaving its position, pursue at a specified distance, and act with varying degrees of independence.

An excellent map and mission editor, strong AI, stable multiplayer (four people on the Internet, eight on a LAN), and dozens of diverse combat units make *Dark Reign* a satisfying, well-rounded entry in an overcrowded field. —*T. Liam McDonald*





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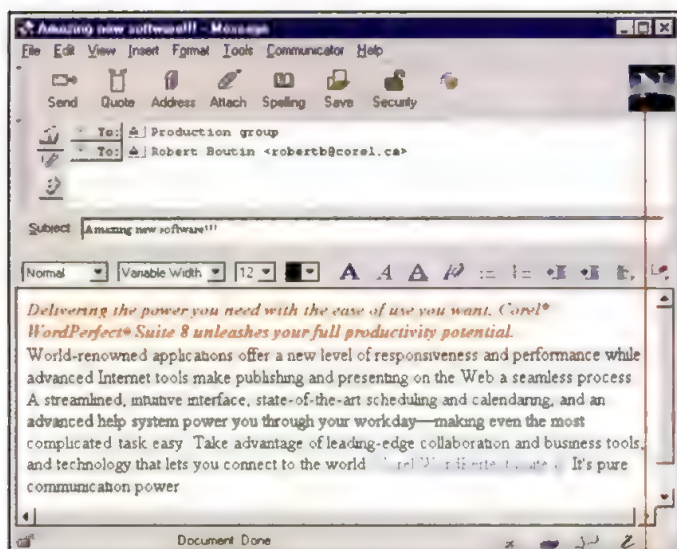
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Imperialism

Conquering the world for fun and profit is a staple of computer gaming, and in the Age of Empire (roughly the 1800s), it was a way of life. Imperialism captures the ebb and flow of this dynamic period with a terrific blend of economics, production, combat, and diplomacy.

A visually stylish game, Imperialism has a look almost reminiscent of a 19th-century watercolor. It runs smoothly on a Pentium/100 with 16MB of RAM and a 4X CD-ROM drive. It's easy to run, but we had some trouble configuring the video drivers so as to keep

the game from crashing.

During each turn, you tend to the areas of your empire by using a series of screens. A main map features "special" units, natural resources, and national borders. The map is filled with squares that offer resources ranging from coal to gold. Special units improve these squares.

Most of the game is spent trying to strike the right balance in your empire. Raw materials must be brought to the factory to create goods for sale or for sustenance. War itself is executed in a simple (and optional) tactical combat mode. Battles take place on a

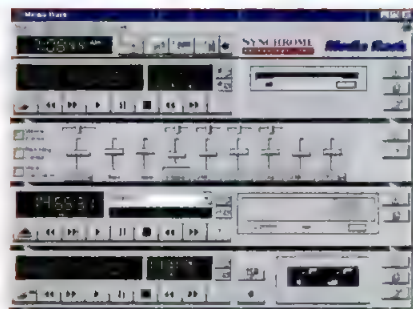


small map and involve moving and shooting. The military element is not particularly deep, but it does provide a welcome diversion from the game's relentless economics.

Imperialism is not a pure game of conquest. Instead, it integrates all the various ele-

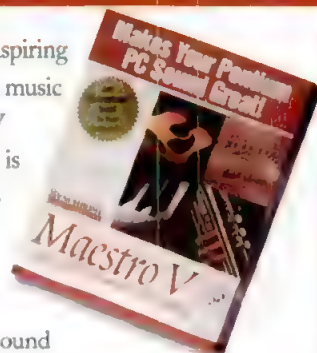
ments of empire: military, trade, diplomatic, and financial. Although the addition of features such as a unit list or a single production screen would make these elements all flow together, Imperialism is an exceptionally well-designed and imaginative game.—TLM

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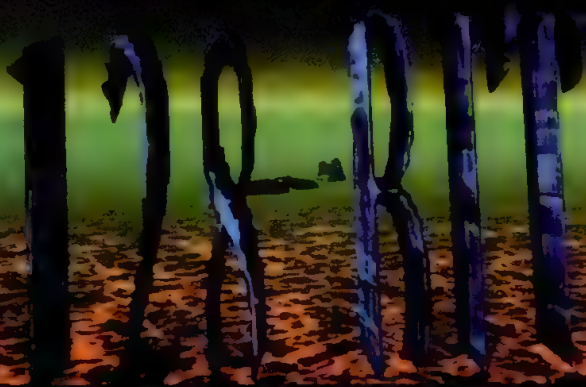
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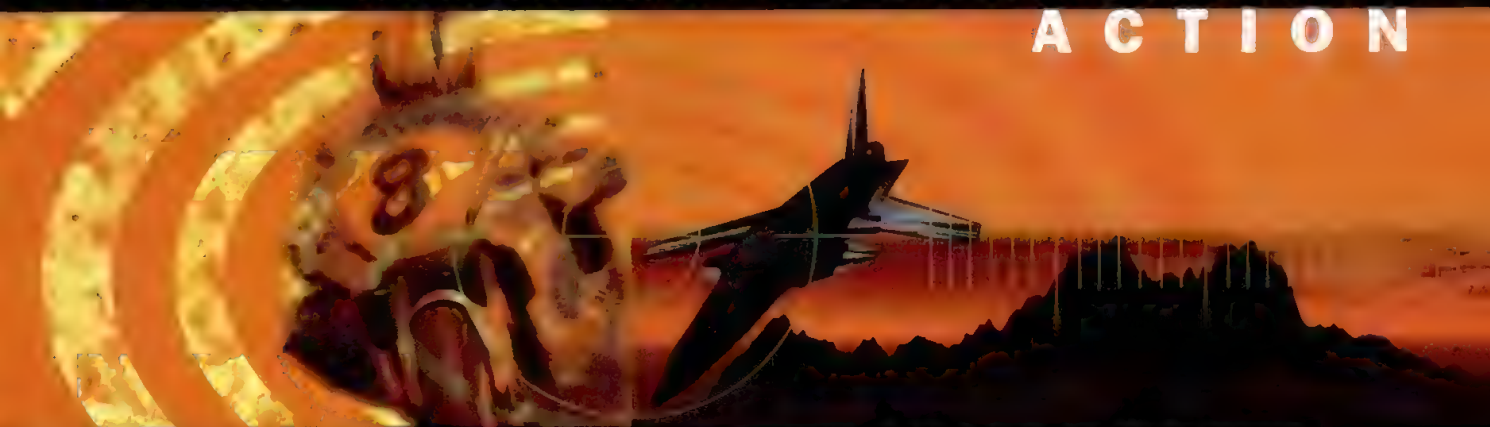
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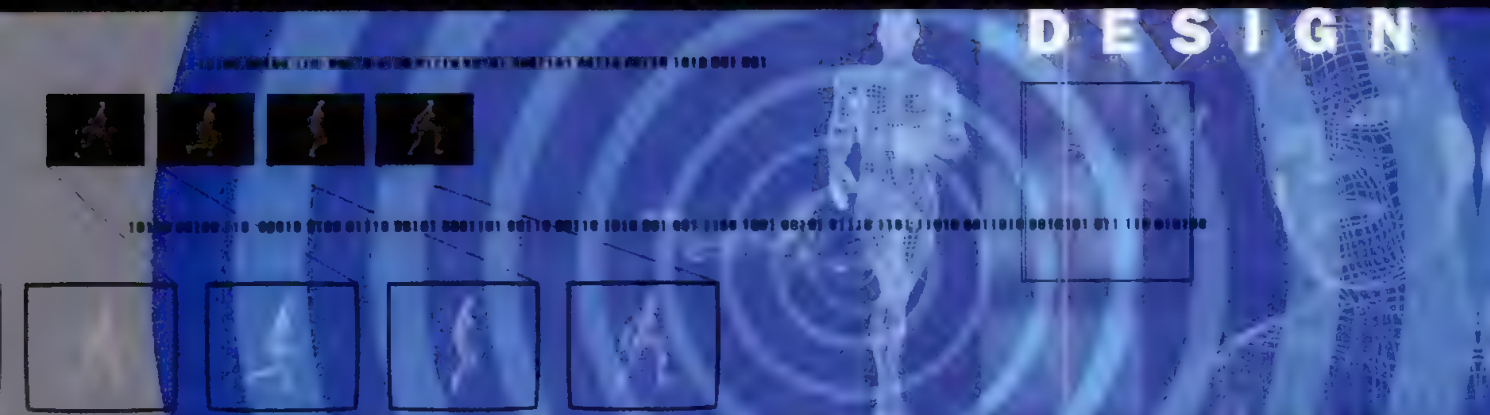
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Coming Up

What's in the Next Issue of *PC Magazine*

Notebook PCs

Time to replace your primary system? Maybe you should jump to a notebook. The next generation is out, and we put them through our rigorous paces. PC Labs tests 30 notebook PCs based on Intel's 233-MHz Tillamook chip. Along with a high-powered CPU, these systems boast other high-end components.

OCR Software

Optical character recognition (OCR) technology is improving and therefore becoming more useful. We'll review seven packages that use OCR with a scanner to turn printed documents into electronic, editable files. These packages offer better word accuracy and speed, and many are much better at picking up page formatting and graphics.

HTML Creation

We look at the latest crop of tools for creating and managing Web sites. Many products have improved their WYSIWYG approach: They help you get your pages up quickly and easily—and create a site structure that will keep visitors happy.



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233MHz COMPLETE SYSTEM

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Five top-of-the-line MMX systems to choose from: the AMD-K6 MMX 233MHz, IBM's 6x86MX PR233, Intel's Pentium MMX 233MHz, or the incredible Pentium II 266 and 300 MHz power-masters. These complete systems are ready to run right out of the box—instantly surfing the Internet, enjoying the latest multimedia CD-ROMs and zipping through the most complex graphics applications. You get an incredibly rich multimedia experience with these MMX-enabled processors—up to twice the multimedia performance with MMX applications!

All of these complete systems include a huge 4.3GB or 6.4GB hard

drive, the fastest 24X CD-ROM drive, 32MB or 64MB of the fastest SDRAM memory, 16-bit SoundBlaster Pro-compatible sound with 3D effects and Yamaha wave table audio, BOCA 56K faxmodem with voice capability, ATI Rage II 3D video for hot graphics and heart-pounding 3D games, Yamaha digital stereo speakers and Microsoft IntelliMouse.

Tiger systems feature the most advanced 64-bit motherboards. Want the fastest hard disk transfer speeds? Then you must have the Ultra DMA-supporting chipsets on these motherboards. The new Western Digital Ultra DMA/33 bursts hard disk data at an astounding 33MB/second. Twice the speed of the previous 16MB/second model! And we teamed it up with the latest Ultra DMA/33 hard disk—amazingly fast and outrageously large! These motherboards also include 2 Universal Serial Bus ports for inexpensive future USB devices, and plenty of expansion slots for extra peripherals (4 PCI/4 ISA, except for Pentium II motherboards, which have 5 PCI/2 ISA/1 AGP). For memory, load up all you could ever want with the 4 SIMM and 2 DIMM memory slots (Pentium II motherboard has 3 DIMM slots).

AGP—Video Breakthrough Of The Decade! Tiger's Pentium II motherboard includes the latest video breakthrough—AGP (Accelerated Graphics Port). This new type of expansion slot makes AGP video run 10



Monitor not included. Add the pictured 15" KDS monitor (viewable 13.7") for just \$239. times faster than PCI! While a PCI adapter can transfer at a maximum of 33MB/second, this new AGP port from Intel can transfer up to 528MB/second! Plus, AGP video can use system memory for graphics—which becomes mandatory for games when 3D textures look their best only when they get 20MBs of video memory. With the included ATI 3D RAGE PRO 2X AGP-powered video adapter, this is the fastest video on Earth—perfect for the latest 3D games, recording live video, audio, and more!

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- PS/2 Mouse Port
- ECP/EPP Parallel Port
- Two USB Ports
- Infrared IrDA Connector
- 512K Pipelined Burst Cache
- 4 PCI/4 ISA Expansion Slots (Pentium II has 5 PCI/2 ISA & AGP)
- 5-Bay Mid-Tower Case
- Triple-Fan Cooling System (Extra Fan in front of case)
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- ATX Motherboard with Case
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- 4MB Video Memory
- 24X CD-ROM Drive
- BOCA 56K Voice/Faxmodem
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Pentium 233 MMX System

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- ATI Rage II 3D Video
- 4MB Video Memory
- 24X CD-ROM Drive
- BOCA 56K Voice/Faxmodem
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A13-S2.3 \$1,359.99
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- 4MB Video Memory
- 24X CD-ROM Drive
- BOCA 56K Voice/Faxmodem
- Yamaha 3D Wave Table Sound
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A13-S2.4 \$1,749.99
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Pentium II 300 MMX System

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- 6.4 GB Ultra DMA/33 Hard Disk
- ATI 3D RAGE PRO AGP 2X Video
- 4MB Video Memory
- 24X CD-ROM Drive
- BOCA 56K Voice/Faxmodem
- Yamaha 3D Wave Table Sound
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A13-NB 4A	Intel Pent. 200MMX	32MB EDO	2.0 GB	20X	13.3" Active Matrix	\$108*	\$3,089.99
A13-NB 5A	Intel Pent. 233MMX	32MB EDO	3.0 GB	20X	13.3" Active Matrix	\$120*	\$3,449.99

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Abort, Retry, Fail?



Greetings from Grammar Hell, Part I

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Greetings from Grammar Hell, Part II

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👉 Highlights from the new \$9.95 Random House book *Stretching at Your Computer or Desk* by Bob Anderson (ISBN 0-679-77084-4). How'd you like to work in the same office as these people?

👉 They must be referring to all those X-rated downloads. (Protec Microsystems ad.)



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👉 Such a deal! (Mindworks ad.)

If your entry is used, we'll send you \$50 and a *PC Magazine* T-shirt. Send your entries to Abort, Retry, Fail?, *PC Magazine*, One Park Ave., New York, NY 10016-5802 or via e-mail (text items only) to don_willmott@z.d.com. Winners this issue: Bob Doan, Jim Milnor, J.H. Pilge, Jeffrey Prince, and Brent Riggs.

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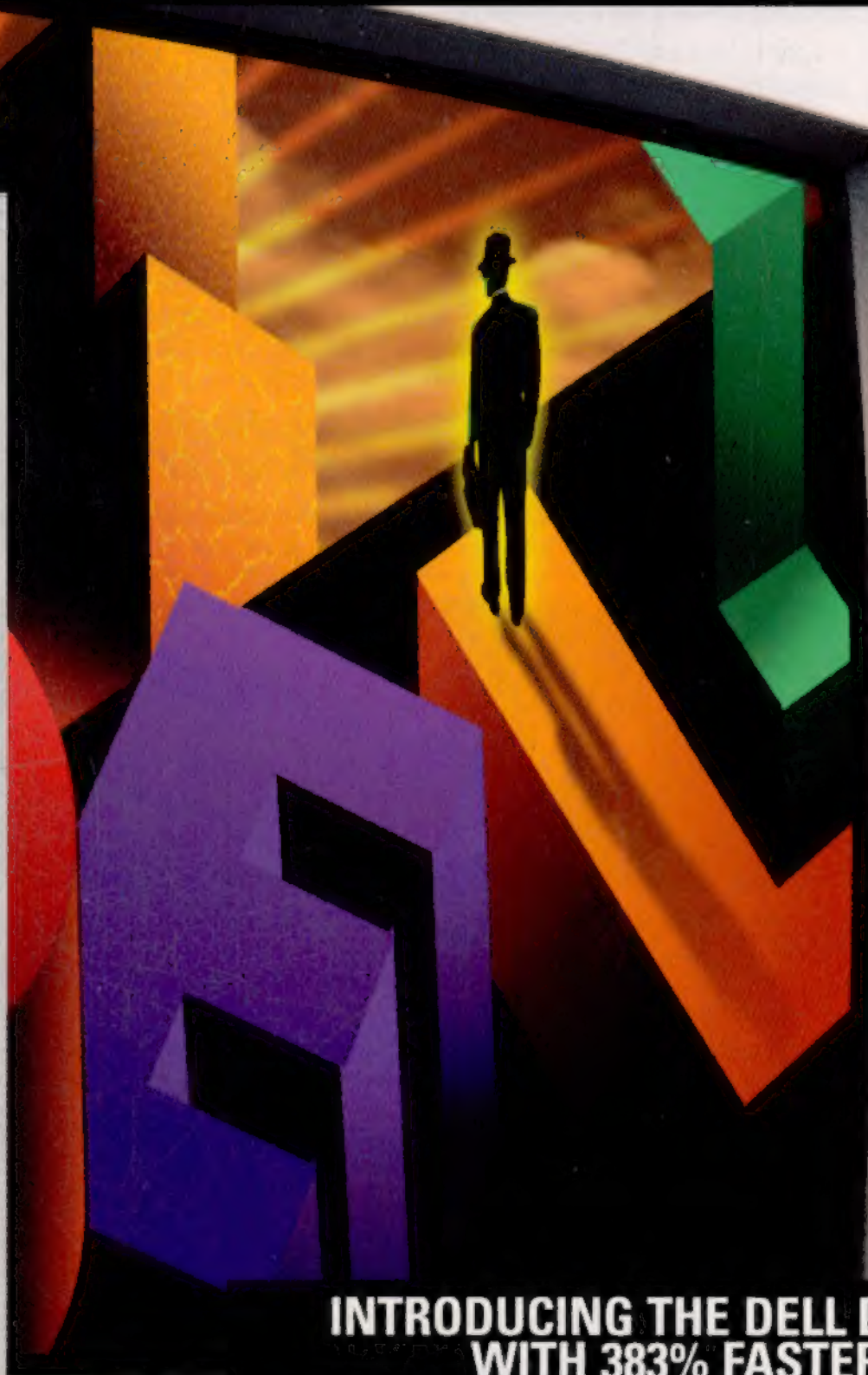
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